Analysis of the Alberni Inlet Chinook Salmon Production System

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TABLE OF CONTENTS

	Page
List of Tables	iv
List of Figures	v
List of Appendices	vi
Abstract	vii
1. Introduction	1
2. Methods	2
2.1. Data processing	2
2.2. Test fishery	2
2.3. Escapement	3
2.4. Catch	3
2.5. River discharge	4
2.6. Modelling	4
3. Results	5
3.1. Problems and data deficiencies	5
3.2. Timing	5
3.3. Age and sex composition	6
3.4. Model	7
4. Discussion	8
5. Recommendations	10
Acknowledgments	10
References	11
Tables	12
Figures	25
Appendix A. Documentation of original data files and summary of computer programs.	39
Appendix B. Summary figures of run timing and Somass River discharge.	51
Appendix C. Model reconstructions for 1978-81.	137

TABLES

		Page
1.	Day to 50% and 90% of cumulative test catch and escapement.	12
2.	Age and sex composition of test catches.	13
3.	Detailed history of chinook tags released and recovered at the Robertson Creek hatchery.	15
4A.	Deduced escapement to Robertson Creek based on recovered marks only.	16
4B.	Age and sex distribution of Robertson Creek escapement based on recovered marks only.	17
4C.	Age and sex distribution of Robertson Creek adult escapement based on recovered marks only.	18
5A.	Deduced escapement to Robertson Creek based on recovered marks and brailer returns.	19
5B.	Age and sex distribution of Robertson Creek escapement based on recovered marks and brailer counts.	20
5C.	Age and sex distribution of Robertson Creek adult escapement based on recovered marks and brailer counts.	21
6.	A comparison between actual returns to Robertson Creek and predicted returns based on recovered marks.	22
7.	Synopsis of model results with a pool time set to 10 days.	23

FIGURES

		Page
1.	Map of study area showing test fishery sites and commercial fishing area.	25
2.	Flowchart of major data processing steps required for analysis of test fishery data.	27
3.	Flowchart of major data processing steps required for analysis of escapement data.	29
4.	Flowchart of major data processing steps required for analysis of commercial, native food, and sport fishery data.	31
5.	Flowchart of major data processing steps required for analysis of Somass River discharge data.	33
6.	Predictions of model for a "typical" case using a 10-day pool time; daily run to fishery and daily escapement.	35
7.	Predictions of model for a "typical" case using a 10-day pool time; cummulative run, pool size, and cummulative escapement.	37

APPENDICES

	Page
Appendix A. Documentation of original data files and summary of computer programs.	39
Table A1. Format of test fishery records.	40
Table A2. DATATREIVE definition for test fishery data base.	41
Table A3. Codes and valid ranges of values for variables in test fishery data fields.	42
Table A4. Format of brailer records.	43
Table A5. Format of commercial gillnet catch records.	44
Table A6. Format of sport fishery records.	45
Table A7. Format of native food fishery records.	46
Table A8. Catalogue of APPLE computer programs.	47
Table A9. Catalogue of VAX computer programs.	49
Appendix B. Summary figures of run timing and Somass River discharge.	51
Fig. B1. Catches of adult males (L) and females (R) in test fishery; 1978-1981. CPUE is in fish per hour.	53
Fig. B2. Returns (fish per day) of adult males (L) and females (R) to brailer; 1974-1981.	63
Fig. B3. Commercial gillnet adult catch (L) and test fishery adult catch (R); 1978-1981. Gillnet catch is fish per day; test fishery is fish per hour.	81
Fig. B4. Returns (fish per day) adults to brailer (L) and Somass River daily discharge (R); 1974-1981. (Discharge data for 1981 not available).	91
Fig. B5. Returns (fish per day) of jacks to brailer; 1973-1981.	109
Fig. B6. Catches of jacks in test fishery; 1978-1981. CPUE is in fish per hour.	121
Fig. B7. Catches of age three fish (L) and age four fish (R) in test fishery 1978-1981. CPUE is in fish per hour.	127
Appendix C. Model reconstructions for 1978-81.	137
Fig. C1. Model reconstructions with a 10-day pool time and parameters shown in Table 5; daily run to fishery and daily escapement.	139
Fig. C2. Model reconstructions with a 10-day pool time and parameters shown in Table 5; cumulative run, pool size and cumulative escapement.	145

ABSTRACT

Sibert, J., and J. Schnute. 1982. Analysis of the Alberni Inlet chinook salmon production system. Can. Tech. Rep. Fish. Aquat. Sci. No. 1131: vii + 149 p.

This report describes available data and presents the results of analysis for the Alberni Inlet chinook salmon production system. Components of this system include a test fishery, commercial fishery, sport fishery, native food fishery, and hatchery with the surrounding river system. Complete histories of these components are presented in graphical form and summarized in tabular form. Timing of the chinook run proves to be extremely consistent from year to year. The test fishery is a good indicator of run timing, stock size, and stock composition. A major problem for this analsis was accessibility to data from different components of the system.

Key words: chinook salmon, run reconstruction, test fishery, modelling.

RESUME

Sibert, J., and J. Schnute. 1982. Analysis of the Alberni Inlet chinook salmon production system. Can. Tech. Rep. Fish. Aquat. Sci. No. 1131: vii + 149 p.

Le présent rapport porte sur les données disponibles et les résultats de l'analyse du système de production de saumons quinnats dans l'inlet Alberni. Les composantes de ce système comprennent une pêche expérimentale, une pêche commercial, une pêche de subsistance pour les autochtones, une pêche sportive et une piscifacture qui englobe le système fluvial avoisinant. La genèse de ces composantes est présentée sous forme graphique et résumée en tableaux. La remontée des saumons quinnats se produit au même moment chaque année. La pêche expérimentale est un bon indicateur de la période de remonte, de la taille du stock et de sa composition. L'accès aux données des différentes composantes du système s'est révélé un problème important au cours de cette analyse.

Mots-clés: saumon quinnats, reconstitution des stocks, pêche expérimentale, modélisation.

1. INTRODUCTION

A modern salmon fishery may include three components. First, there is a facility for artificial propogation of stock, such as a hatchery or spawning channel. Second, there is a fishery which may also be comprised of several components, such as one or more fleets of commercial fishing vessels, a number of sport fishermen, and often a native food fishery. Third, there is a test fishery conducted to monitor either available stock or escapement. Although typically some degree of coordination is achieved during management of the fishery to ensure that in-season goals are met, each of these components may operate independently and be managed according to different purposes. Consequently, record keeping and data management may fail to be coordinated, and there may be no formalized method of integrating information at the system level. Typically, there is little practical recognition that these three components contain information about the overall performance of a salmon producing and harvesting system.

The purpose of the work described here is to explore possibilities for integrating the components of such a system. The Barkley Sound and Alberni Inlet chinook fishery was chosen because of its relative simplicity. The Robertson Creek Hatchery began releasing chinook smolts in 1972, and the first returns to contain 3-, 4-, and 5-year-old fish occurred in 1977. The fishery is a terminal gillnet fishery, and the first opening occurred in 1978, accompanied by a test fishery.

Several steps were involved in the study: collating of data from various sources, rendering data machine-readable, analysis and summary of data, and developing a synthetic picture of the whole system. In many ways this study has been like a detective story within a detective story. On the outer level, it was necessary to ferret out the data and interpret the actions of those who gathered it initially. On the inner level, it was necessary to try to reconstruct actual runs of fish, various fisheries, and escapements and finally to draw some conclusions. The purpose of this paper is to summarize and document these steps, outline the results of the model, and make recommendations regarding future data management in salmon production and harvesting systems.

The Robertson Creek - Alberni Inlet system is located on the southwest coast of Vancouver Island, British Columbia. The hatchery at Robertson Creek is about 20 km from tide water on a tributary of the Stamp River which is the outflow from Great Central Lake. There is a dam on the Stamp which regulates the flow regime in the lower Somass River system. The Stamp is a tributary to the Somass which enters Alberni Inlet near the city of Port Alberni. Alberni Inlet is a long (50 km), narrow (1-2 km) fjord which contains the estuary of the Somass River. Alberni Inlet connects to the Pacific Ocean through Barkley Sound, a protected body of water containing many islands. A sport fishery occurs throughout the system from Barkley Sound to Port Alberni. A commercial gillnet fishery occurs between Sproat Narrows and Polly Point in Alberni Inlet. A native food fishery occurs in the lower 1-2 km of the Somass River. These areas are shown in Fig. 1.

2. METHODS

2.1. Data processing

A large number of data processing steps were required in this analysis. Outlines of these steps are shown in flowchart form for each component (Fig. 2-5). Catalogues and brief descriptions of computer programs written for this project are presented in Tables A8 and A9 of Appendix A. The original data, in a basically unprocessed state, are stored on a magnetic tape (indicated as "MASTER" in the flowcharts). Formats of the records on this tape are also given in Appendix A. Copies of this tape will be made available to interested users on request.

2.2. Test fishery

A commercial fishery on Robertson Creek stocks was anticipated in 1978 and a test fishery was instituted to ascertain the stock of fish available to the fishery and the relative contributions of wild and hatchery fish to the stock. A commercial gillnetter was chartered to conduct the test fishery. All test sets were conducted at night and were typically of about 2 hours duration. The test fishery period was from early August through mid-September. A special gillnet consisting of five panels of 50 fathoms each of differing mesh size (5-1/4, 5-7/8, 6-1/8 inches) was used initially. Subsequently, other mesh sizes were used in relation to the regulations imposed on the commercial fleet (see Table A3). All chinooks caught in the test fishery were sampled for hypural length, sex, and the presence of coded-wire nose tags. Scales were also taken for age determination and stock identification.

Data for 1978, 1979, and 1980 were collated from files in the Port Alberni and Nanaimo Fisheries Offices and from the logbooks of the fishing vessel. A program was written for an APPLE microcomputer to record the data and correct errors (Lee and Associates, 1981). Data for 1981 were recorded directly on coding forms which were later transcribed to magnetic tape. All data were eventually stored in the VAX computer at the Pacific Biological Station and were made compatible with the data base management utility, DATAREIVE. This utility was used for final error correction.

A record of test fishery data consists of information on a fish as well as information about the set from which the fish was taken. The format of the records is given in Table A1 and the DATAREIVE definition is given in Table A2. Various codes used in recording data are given in Table A3. A flowchart outlining data processing steps associated with test fishery data is given in Fig. 2.

2.3. Escapement

Hatchery records are the primary source of escapement data. These consist of daily or bi-daily counts of returning fish captured in the brailer at the Robertson Creek hatchery. Numbers of chinook jacks, chinook adult males, chinook females, coho jacks, coho adults, steelhead, and sockeye are recorded. Marked and unmarked fish are recorded separately. Copies of the hatchery brailer records were obtained, annotated for clarity and date, transcribed to magnetic tape, and stored on the VAX as file BRAILER.DAT. Errors were checked by comparing the running daily total to those in the brailer records at the hatchery. A second brailer file, BRAILNEW.DAT, was created which is sorted by date and contains a code for mark. This file was used to select chinooks and create summary files for run time analysis and plotting. The BRAILNEW file also exists in an APPLE version which is compatible with the data base management utility VISIFILE. Summary files exist in VAX, APPLE, and APPLEPLOT-compatible versions.

There are other escapements of chinook into the Somass system. The origin of these so-called 'wild' fish is not known. They may be strays from Robertson Creek or they may be remnants of the ancestral brood stock. The abundance of these fish is estimated occasionally during the run by Fisheries Officers in Port Alberni. The accuracy of these estimates is unknown, and they are not done with sufficient frequency to infer timing. Due to the lack of timing information, the "wild" escapement estimates are simply used in this analysis to increase escapement estimates proportionally over the whole run.

The format of escapement records is given in Table A4. A flow chart of data processing steps for escapement data is presented in Fig. 3.

2.4. Catch

Chinooks from Robertson Creek are caught in at least four different fisheries: an offshore (including possible foreign) commercial troll fishery, a sport fishery in Barkley Sound and Alberni Inlet, a terminal gillnet fishery in Alberni Inlet, and a native food fishery in the Somass River. Few data are available on the offshore fisheries and are not easily applied to the present analysis. Records of all other fisheries are kept in the D.F.O. office in Port Alberni. For the gillnet fishery, numbers of jacks and adults caught, numbers of nets, and duration of opening are recorded by opening. For the sport fishery, numbers of jacks and adults caught are recorded by week. For the food fishery, numbers of jacks and adults caught, days open, and number of nets are recorded by week.

Computer programs for an APPLE microcomputer were written to record these data. Formats of catch files are given in Tables A5-A7. A flowchart of all data processing steps associated with catch data is presented in Fig. 4.

2.5. River discharge

Escapement of fish to the river is often considered to be associated with the stage of the river. Daily discharge records for the Somass River were obtained from Inland Waters Directorate in Ottawa. These data pertain to station OHB017, Somass River near Alberni, and were provided on magnetic tape in format "79-041" (Inland Waters Directorate, 1980) as a single file for the years 1974 through 1980. The file was transferred to the VAX computer and a program written to break down the file into separate files containing daily discharge for each year. These files were transferred to an APPLE microcomputer where a program prepared the data for display by the APPLEPLOT utility. A flowchart of a data processing steps associated with river discharge is presented in Fig. 5.

2.6. Modelling

A model, ALBERNI, of the salmon run through the fishery and into the hatchery was constructed and is described in detail elsewhere (Schnute and Sibert, in prep.). Briefly, the model contains the following assumptions: (1) For every day on which fish return to the hatchery, there is a corresponding day on which fish enter the fishery area. (2) Migration rate of fish is variable, i.e., fish which arrive in the fishery late may migrate faster than fish which arrive in the fishery early. (3) Fish remain in the fishery for a finite period of time, possibly many days. (4) Fish arrive in the fishery according to a smooth curve which has a single peak and variable skewness and flatness. Each of these assumptions is associated with one or more parameters which in aggregate completely define a particular scenario for a run and fishery. In the model, catch is added back to escapement on the appropriate day subject to two criteria. First, the resulting run curve should be as smooth as posible. Second, the calculated number of available fish each day should best conform to the actual observed catch per set of the test fishery. Parameters are estimated using a direct search numerical method (Schnute, 1982).

Input to the model consists of three files containing data on hatchery and wild escapement, commercial catch (including commercial gillnet, sport, and native food catches) and test catch by day. Data processing steps to develop these files are shown in Fig. 2, 3, and 4.

3. RESULTS

3.1. Problems and data deficiencies

The fisheries data required for this analysis were collected for the primary purpose of in-season fishery management and were not intended for use in an historical analysis. This simple fact produced a number of practical difficulties. First, the data were stored in at least four different locations: D.F.O. offices in Nanaimo and Port Alberni, Robertson Creek Hatchery, and a fishing boat. Second, none of the data were machine-readable nor were they recorded in consistent formats. Third, there were frequent communications difficulties regarding which data were actually required. Fourth, data were often obtained which were the results of calculations but the assumptions and formulas used were not given. As a net result of all these problems, considerable effort was spent in obtaining data and rendering it free of errors in a computer-compatible format. These tasks and the initial analysis of the empirical data consumed the major part of one person-year of resources.

Unfortunately, some aspects of the data are still incomplete. For the test fishery, information on wind, tide, mesh, location, and even duration of set were not consistently recorded. In such cases, the information is coded as missing (see Table A3). For sets where set duration was not recorded, 2 hours was arbitrarily used in effort calculations.

These comments should not be interpreted as criticisms of the staff involved nor of their various programs. Rather it is the result of the season-by-season management policy for both fishery and hatchery. Given the opportunity to participate in a comprehensive post-season analysis, fisheries staff from all parts of the system showed enthusiasm and willingness to help compile the requisite data and plan improved future data acquisition.

3.2. Timing

Timing of test catch, commercial gillnet catch, and escapement to the hatchery by age and sex as well as Somass River discharge are presented in the figures in Appendix B.

Catch and run timing may be summarized by calculating the Julian day on which 50% and 90% of the catch or run had occurred. These estimates are presented in Table 1. Females precede males in the test fishery by about a day, whereas males precede females in the hatchery by 4 to 8 days. Although variation among years in the test fishery is apparently great, escapement to the brailer is remarkably consistent from year to year. On average, 50% of the run arrives at the hatchery about 60 days after 50% of the run passes the fishery.

Conduct of the test fishery varied among years and this point should be remembered in interpreting timing of the run through the fishery. The following short table summarizes the extent of test fishing in 1978-81:

Year	First Day	Last Day
1978	Aug. 15 (227)	Oct. 25 (298)
1979	Aug. 13 (225)	Sept. 9 (252)
1980	Aug. 5 (217)	Sept. 14 (257)
1981	Aug. 11 (223)	Sept. 2 (245)

The first day of test fishing ranged from August 5 to August 11. The last day of day of test fishing varied more substantially between September 2 (in 1981) and October 25 (in 1978). The early termination of the 1981 test fishery may have occurred prior to the peak abundance of migrants into the fishery.

Commercial catches strongly influence both the test fishery and immediately subsequent commercial catches. Large dips occur in test fishery CPUE following a commercial opening. Similarly, commercial catches decrease markedly on the second day of a 2-day opening.

Timing of the migration in relation to river discharge varies among years. In the 1975, there is some association between discharge and brailer return (Fig. B4-75, L and R). However, in other years, timing of river discharge is such that the majority of the hatchery escapement occurs prior to the onset of freshet. In general most escapement occurs during a declining hydrograph.

3.3. Age and sex composition

Composition of test catches is shown in Table 2. Gillnets are highly selective for larger fish and jacks are probably not adequately represented in catches. Therefore, sex and age composition was calculated both including and excluding jacks. Sex composition ranges from 19% to 54% female. Age 3 and 4 fish are the most common age classes. There is a strong association between age and sex so that age 3 and younger fish are predominantly male and age 4 and older fish are predominantly female. Consequently, in years when either age 3 or age 4 adults are poorly represented, adult sex ratio tends in the direction of female or male, respectively.

Returns of coded-wire tags (CWT) to the hatchery may provide a reliable indication of the age and sex composition of returning fish. Table 3 summarizes all information concerning the release and recovery of fish marked with CWTs. These data were used to estimate the number of fish returning to the brailer by code. Estimates by code were then aggregated by brood year and sex to yield the age and sex composition in Table 4A. Proportions at age and sex were calculated both including and excluding jacks and are reported in Tables 4B and 4C. Total numbers of jacks, adult males and females returning to the brailer and the adult proportions by age in Table 4C were used to calculate age and sex composition of the brailer counts which is given in

Table 5A. Proportions including and excluding jacks of total brailer counts are given in Tables 5B and 5C, respectively. Adult age and sex composition of the brailer return (Table 5C) agrees reasonably well with the adult age and sex composition found in the test fishery (Table 2).

The extrapolated CWT returns can be considered predictions of the total number of fish. As Table 6 shows, however, tagged stocks account on average for only about 60% of actual returns counted in the brailer. Four possible explanations might be given. First, tagging mortality could cause fewer than the expected number of tags to turn up in the mature population. Second, tagged fish, as indicated by a missing adipose fin, might fail to be detected in the brailer. Third, tagged fish might be more vulnerable to the fishery, as could happen if tagged fish were smaller on average. Fourth, a significant number of mature fish in the hatchery might come from wild stocks in the river system. This would occur if there were a high degree of mixing between hatchery and wild stocks.

Of these four explanations, the first two are perhaps least likely, and the last two are testable. First, the mark-release ratio used here (Table 1) is based on smolt counts after an initial mortality period, so that further differential tagging mortality to the extent shown above seems unlikely, although possible. Second, trained hatchery staff probably do better than a 60% detection rate of marked fish. If the third explanation were true, data on adult size should exhibit a difference between marked and unmarked fish. This could easily be checked. Similarly, if the fourth explanation were valid, significant numbers of marked fish should appear among the wild escapement, and a sampling program could be conducted to check this possibility.

3.4. Model

Figures C1-C2 show the predictions of the model for the years 1978-1981. The parameters used to obtain these predictions are listed in Table 7. Models such as this one often produce more than one prediction (that is, more than one set of reasonable parameters) which is consistent with the observations. For example, pool time (time spent by fish in the fishery) is a particularly ambiguous parameter. For reasons documented in Schnute and Sibert (1982), a pool time of 10 to 20 days seems likely. A pool time of 10 days is used for all examples in Table 7, including the "typical" case.

The model obtains the parameters of Table 7 by searching for a scenario of run timing and fishing which is most consistent with the data. When this optimal scenario is found, there corresponds an actual run of fish: the result of adding the catch back into the escapement. Fig. C1 and C2 should be interpreted in this light. They represent how the various runs of fish theoretically would have occurred if there had been no fishery.

Relative timing and skewness of the runs are illustrated in Fig. C1. The role of the run compression factor in Table 7 can be seen in the sharp peak of the escapement curve in relation to the fishery curve. The percent of the run which arrives by the peak day is an indication of

skewness. A perfectly symmetric run would have exactly 50% of the run completed by the peak day. Percentages greater than 50% indicate skewness to the right, and percentages less than 50% indicate runs skewed left. This parameter varies among years but is near 50% on average. In most other respects, there is considerable consistency in model parameters among years.

The pool size as a proportion of the whole run is shown in Fig. C2. Pool size is, of course, strongly influenced by pool time: the longer the pool time, the more fish in the pool. The cumulative run curves in Fig. C2 indicate the proportion of the total run which has reached the pool midpoint. On September 1, 1978 (day 244, Fig. C2-78), for example, about 48% of the run had passed the midpoint of the pool. Fig. C2-78 can also be used to estimate the safe proportion of the run if the fishery were closed on a particular day, say, on September 1. That day the pool contains fish which arrived in the fishery between days 234 and 244. All fish arriving after day 244, that is, all those destined to reach the pool midpoint after day 249, would be protected. On day 249, about 57% had reached the midpoint, so the remaining 43% would be safe.

DISCUSSION

Consistent, precise timing of migration is the most striking characteristic of this fishery system, and is reflected by both empirical observations (Table 1) and model results (Table 7). Fish move into the river to spawn at almost the same time every year. Determinants of this migration are not known with certainty, but biologists generally agree that fluvial events are important regulators. Some claim that migration is triggered by increasing flows, while others argue for a subtle interaction between temperature and declining flows. Thus the most obvious environmental cue, river discharge, cannot simply be associated with escapement. The bulk of the migration occurs prior to significant increases in river stage. Furthermore, variation in timing of river discharge among years is much greater than variation in timing of escapement. It is therefore reasonable to construct a generalized model for migration of fish into both fishery and hatchery without recourse to environmental cues.

The predictions of such a model are summarized in Table 7, Fig. 6, Fig. 7, and Appendix C. In the typical case, fish reach their maximum abundance in the fishery on day 244 (September 1); they remain in the pool for 10 days, and 90% of the run has passed by day 263 (September 20). The peak of the run and half of the total migration arrives at the hatchery on day 299 (October 26) and 90% of the fish will have completed their migration by day 308 (November 4). On average, the test fishery can be expected to catch about 0.1% of the pool of fish per hour of fishing effort. Runs vary in detail from year to year but this general prediction is consistent with all years 1978-81. Much of the year-to-year variation can be accommodated by the skewness parameters so that more or less than 50% of the total run will have migrated by the peak day. Coupled with a preseason prediction of total run size, the run timing model will provide a useful estimate of the pool of fish

available to the fishery on any date. Such predictions should obviously be substantiated by a test fishery, and should also suggest approximate times for test fishing.

Differences among years in timing of the test fishery must obviously have an effect on the apparent timing results, such as those presented in Table 1. To obtain maximum benefit from the test fishery, it should span the period during which fish are predicted to be returning to the fishery area. This requirement means conducting test sets at times when fish abundance is expected to be low, that is on the ascending and descending tails of the predicted run. In particular, test fishing should continue well beyond the time when maximum abundance occurs.

The discrepancy between observed counts of fish at the brailer and numbers calculated from CWT returns is puzzling. Four possible explanations are presented above in section 3.3, and suggestions are given for checking the two most likely.

The general agreement between the age and sex composition of the test catch and the brailer returns is encouraging. The problem of obtaining sufficient brood stock has been a continuing concern of the hatchery staff. In 1979 and 1981, fewer than 5,000 adult females returned to the hatchery. Since escapement occurs well after the major fisheries, some advance indication of any serious problem is very important. The test fishery should provide such an indication, at least for the male/female ratio. Also, samples of the commercial catch would improve the estimate of this ratio.

A number of subjects have not been examined in this analysis which are reserved for others to pursue. There are potentially important differences in run timing between sexes and among ages. The run timing model could be applied to females only, for instance, in order to predict more accurately escapement of brood stock to the hatchery. Unfortunately, age and sex compositions are not available from any of the fisheries and would have to be extrapolated from either test fishery or brailer data. Alternatively, a commercial catch sampling program could be initiated.

In the test fishery analysis, all stations were pooled. There are certainly differences in test fishery success from different sites, times of day, and stages of tide. Furthermore, there is good information on length and age. Analysis of these topics, in particular site differences, could contribute to improvement of the test fishery and might eliminate some of the ambiguous solutions in the model.

A significant uncertainty is the importance of "wild" spawners. There has apparently been no effort made to determine the origin of these fish by spawning ground sampling. Such sampling for recovery of coded-wire tags and scales would provide useful information not only on origin but might also yield a more accurate estimate of abundance based on proportion of marked fish.

Perhaps the most serious difficulty encountered in the work was the difficulty in obtaining the data required. There is no organized system for uniform recording of data. Nor is there any formalized processes for ensuring or even enabling data to be shared among components of the fish-producing and

harvesting system. This situation is unacceptable from three points of view. First, all tools of fishery management must be applied. This means that all available sources of information must be easily and quickly available. Second, the data have value beyond the season and immediate purpose for which they were collected. Analysis of the historical record may be of considerable value, as in the present example, but is made difficult by the lack of consistent methods of recording and sharing data. Third, uniform and consistent data collection is a prerequisite to any coast-wide system of salmon inventory and management.

RECOMMENDATIONS

(1) That a system for uniform, consistent, and timely data acquisition be implemented in all major DFO facilities, including Fisheries Offices as well as hatcheries. Data should be recorded in machine readable, standardized formats and be accessible by well documented software.

(2) That the Alberni Inlet chinook test fishery be continued. The test fishery provides reliable information on abundance, as well as age and sex composition of the escapement run. Samples from the commercial catch would also provide valuable information on run composition.

(3) That a program of stream sampling be initiated to recover CWTs from so-called "wild" spawners.

(4) That a study of the relative sizes of marked and unmarked fish returning to the hatchery be conducted to determine if marking might influence adult size, and, therefore, potential vulnerability to the fishery.

(5) That a mark and recovery program be instituted in conjuncion with the test fishery. This program would provide direct estimates of pool time, pool size, and migration rate to the hatchery.

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Table 1. Day to 50% and 90% of cumulative test catch and escapement.

	Year									
	1973	1974	1975	1976	1977	1978	1979	1980	1981	Mean[1]
A. 50% Test Fishery										
Jacks						250	226	247	242	241
Adult Males						245	242	236	235	240
Females						242	240	235	233	238
Adults						243	241	235	235	238
B. 90% Test Fishery										
Jacks						259	238	252	244	248
Adult Males						268	245	250	243	252
Females						265	246	249	242	250
Adults						265	245	249	243	250
C. 50% Brailer										
Jacks	296	309	295	292	290	296	293	292	301	294
Adult Males		301	301	292	295	292	295	292	295	294
Females		299	299	295	295	297	300	300	299	298
Adults		301	301	294	295	296	296	295	295	295
D. 90% Brailer										
Jacks	303	316	306	301	299	306	304	306	307	304
Adult Males		320	321	300	306	303	308	305	305	304
Females		308	322	301	307	308	309	307	307	306
Adults		320	321	301	306	306	308	307	305	306

[1] Brailer averages include years 1976-1981 only.

Table 2. Age and sex composition of test catches.

Return Year	Sex	Counts: Age 2	3	4	5	>=6	Sum	Adults
1978	Male	144	193	168	8	0	513	369
	Female	2	16	334	26	1	379	377
	Sum	146	209	502	34	1	892	746
1979	Male	34	705	61	10	0	810	776
	Female	0	52	75	60	0	187	187
	Sum	34	757	136	70	0	997	963
1980	Male	6	198	124	5	0	333	327
	Female	2	139	229	24	1	395	393
	Sum	8	337	353	29	1	728	720
1981	Male	34	295	55	8	0	392	358
	Female	0	16	77	31	0	124	124
	Sum	34	311	132	39	0	516	482

Return Year	Sex	Percentages including jacks: Age 2	3	4	5	>=6	Sum
1978	Male	16.14	21.64	18.83	0.90	0.00	57.51
	Female	0.22	1.79	37.44	2.91	0.11	42.49
	Sum	16.37	23.43	56.28	3.81	0.11	100
1979	Male	3.41	70.71	6.12	1.00	0.00	81.24
	Female	0.00	5.22	7.52	6.02	0.00	18.76
	Sum	3.41	75.93	13.64	7.02	0.00	100
1980	Male	0.82	27.20	17.03	0.69	0.00	45.74
	Female	0.27	19.09	31.46	3.30	0.14	54.26
	Sum	1.10	46.29	48.49	3.98	0.14	100
1981	Male	6.59	57.17	10.66	1.55	0.00	75.97
	Female	0.00	3.10	14.92	6.01	0.00	24.03
	Sum	6.59	60.27	25.58	7.56	0.00	100

Table 2. (cont'd)

Return Year	Sex	Percentages without jacks				
		Age				
		3	4	5	>=6	Sum
1978	Male	25.91	22.55	1.07	0.00	49.53
	Female	2.15	44.83	3.49	0.13	50.47
	Sum	28.05	67.38	4.56	0.13	100
1979	Male	73.21	6.33	1.04	0.00	80.58
	Female	5.40	7.79	6.23	0.00	19.42
	Sum	78.61	14.12	7.27	0.00	100
1980	Male	27.54	17.25	0.70	0.00	45.48
	Female	19.33	31.85	3.34	0.14	54.52
	Sum	46.87	49.10	4.03	0.14	100
1981	Male	61.20	11.41	1.66	0.00	74.27
	Female	3.32	15.98	6.43	0.00	25.73
	Sum	64.52	27.39	8.00	0.00	100

Table 3. Detailed history of chinook tags released and recovered at the Robertson Creek Hatchery.

YE	CODE	MARKS	RELEASES	M/R	JM	JF	3M	3F	4M	4F	5M	5F	6M	6F	TOTAL
72	W/8L/W/8L	1580	1580	1	7	0	0	0	1	1	0	0	0	0	9
72	05/02/01	26881	568041	.0473222	36	0	37	2	22	28	3	15	0	0	143
72	08/02/01	40054	299312	.1338202	18	0	1	0	1	2	0	0	0	0	22
73	08/02/06	20586	73094	.2816373	7	0	3	0	6	1	0	0	0	0	17
73	07/02/06	23044	23044	1	0	0	1	0	1	0	1	0	0	0	3
73	05/02/06	28493	520930	.0546964	1	0	1	0	2	1	2	0	0	0	7
73	04/02/06	28980	438094	.0661501	9	0	12	1	10	8	1	5	0	0	46
73	02/02/03	25174	603717	.0416983	10	0	16	0	13	10	0	2	0	0	51
73	06/02/02	16137	29352	.5497751	19	0	24	3	9	25	1	9	0	0	90
74	06/02/06	23254	484125	.0480330	206	1	330	29	45	179	2	32	0	0	874
74	09/02/06	27383	453766	.0603460	59	0	194	5	35	69	0	12	0	1	375
74	12/02/06	11674	11674	1	48	0	121	22	10	42	0	2	0	0	245
75	13/02/05	10702	10829	.9882722	4	0	11	4	1	11	0	3	0	0	34
75	04/02/08	50731	487145	.1041394	114	0	115	15	40	93	2	21	0	0	400
75	04/02/09	47724	462985	.1030789	67	0	92	8	41	76	1	26	0	0	311
76	16/02/29	59227	63054	.9393059	152	0	178	93	8	55	0	1	0	0	487
76	16/02/31	69203	442487	.1563955	33	0	129	5	60	62	2	10	0	0	301
76	16/02/30	64550	3188072	.0202473	82	0	232	21	78	90	1	4	0	0	508
77	22/02/17	70816	5530073	.0128056	82	0	40	3	2	11	0	0	0	0	138
77	22/02/18	66725	2902936	.0229853	82	0	53	2	2	3	0	0	0	0	147
78	16/02/35	74711	2234694	.0334323	130	0	79	10	0	0	0	0	0	0	219
78	17/02/51	26699	27384	.9749853	11	0	12	1	0	0	0	0	0	0	24
78	16/02/15	76418	2567281	.0297661	53	0	33	0	0	0	0	0	0	0	86
78	20/02/03	27313	27313	1	11	0	9	0	0	0	0	0	0	0	20
78	16/02/06	27268	27824	.9800172	6	0	3	1	0	0	0	0	0	0	10
79	18/02/06	20931	21424	.9769384	4	0	0	0	0	0	0	0	0	0	4
79	18/02/05	20733	21049	.9849874	1	0	0	0	0	0	0	0	0	0	1
79	18/02/29	82088	3787031	.0216760	52	0	0	0	0	0	0	0	0	0	52
79	18/02/07	20789	20789	1	0	0	0	0	0	0	0	0	0	0	0
79	18/02/27	76768	3437025	.0223355	19	0	0	0	0	0	0	0	0	0	19
79	17/02/15	20449	20909	.9779999	6	0	0	0	0	0	0	0	0	0	6

Table 4A. Deduced escapement to Robertson Creek Hatchery, based on recovered marks only. These are obtained by expanding the recoveries in Table 3 by the ratio of released to marked fish.

YEAR	SEX	JACKS	3 YRS.	4 YRS.	5 YRS.	6 YRS.	T.ADULTS	TOTAL
1974	MALE	901	0	0	0	0	0	901
	FEMALE	0	0	0	0	0	0	0
	SUM	901	0	0	0	0	0	901
1975	MALE	451	788	0	0	0	788	1239
	FEMALE	0	42	0	0	0	42	42
	SUM	451	830	0	0	0	830	1281
1976	MALE	5313	636	472	0	0	1108	6421
	FEMALE	20	20	606	0	0	626	646
	SUM	5333	656	1078	0	0	1734	7067
1977	MALE	1747	11246	536	63	0	11845	13592
	FEMALE	0	707	425	316	0	1448	1448
	SUM	1747	11953	961	379	0	13293	15040
1978	MALE	4421	2007	1525	53	0	3585	8006
	FEMALE	0	225	4911	138	0	5274	5274
	SUM	4421	2232	6436	191	0	8859	13280
1979	MALE	9970	12471	782	41	0	13294	23264
	FEMALE	0	1167	1641	866	0	3674	3674
	SUM	9970	13638	2423	907	0	16968	26938
1980	MALE	5696	5646	4243	28	0	9917	15613
	FEMALE	0	321	4899	456	16	5692	5692
	SUM	5696	5967	9142	484	16	15609	21305
1981	MALE	3259	3494	243	61	0	3798	7057
	FEMALE	0	301	988	261	0	1550	1550
	SUM	3259	3795	1231	322	0	5348	8607
TOTAL	MALE	31758	36288	7801	246	0	44335	76093
	FEMALE	20	2783	13470	2037	16	18306	18326
	SUM	31778	39071	21271	2283	16	62641	94419

Table 4B. Age and sex distribution of Robertson Creek Hatchery escapement, based on recovered marks only. These are calculated directly from Table 4A.

YEAR	SEX	JACKS	3 YRS.	4 YRS.	5 YRS.	6 YRS.	T.ADULTS	TOTAL
1974	MALE	100.00	0.00	0.00	0.00	0.00	0.00	100.00
	FEMALE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SUM	100.00	0.00	0.00	0.00	0.00	0.00	100.00
1975	MALE	35.21	61.51	0.00	0.00	0.00	61.51	96.72
	FEMALE	0.00	3.28	0.00	0.00	0.00	3.28	3.28
	SUM	35.21	64.79	0.00	0.00	0.00	64.79	100.00
1976	MALE	75.18	9.00	6.68	0.00	0.00	15.68	90.86
	FEMALE	0.28	0.28	8.58	0.00	0.00	8.86	9.14
	SUM	75.46	9.28	15.26	0.00	0.00	24.54	100.00
1977	MALE	11.62	74.77	3.56	0.42	0.00	78.75	90.37
	FEMALE	0.00	4.70	2.83	2.10	0.00	9.63	9.63
	SUM	11.62	79.47	6.39	2.52	0.00	88.38	100.00
1978	MALE	33.29	15.11	11.48	0.40	0.00	26.99	60.28
	FEMALE	0.00	1.69	36.98	1.05	0.00	39.72	39.72
	SUM	33.29	16.80	48.46	1.45	0.00	66.71	100.00
1979	MALE	37.01	46.30	2.90	0.15	0.00	49.35	86.36
	FEMALE	0.00	4.33	6.09	3.22	0.00	13.64	13.64
	SUM	37.01	50.63	8.99	3.37	0.00	62.99	100.00
1980	MALE	26.74	26.50	19.92	0.13	0.00	46.55	73.29
	FEMALE	0.00	1.51	23.00	2.12	0.08	26.71	26.71
	SUM	26.74	28.01	42.92	2.25	0.08	73.26	100.00
1981	MALE	37.86	40.59	2.82	0.71	0.00	44.12	81.98
	FEMALE	0.00	3.50	11.48	3.04	0.00	18.02	18.02
	SUM	37.86	44.09	14.30	3.75	0.00	62.14	100.00
TOTAL	MALE	33.64	38.43	8.26	0.26	0.00	46.96	80.59
	FEMALE	0.02	2.95	14.27	2.16	0.02	19.39	19.41
	SUM	33.66	41.38	22.53	2.42	0.02	66.34	100.00

Table 4C. Age and sex distribution of Robertson Creek Hatchery adult escapement, based on recovered marks only. These are calculated from Table 4A, excluding jacks.

YEAR	SEX	3 YRS.	4 YRS.	5 YRS.	6 YRS.	T.ADULTS
1974	MALE	0.00	0.00	0.00	0.00	0.00
	FEMALE	0.00	0.00	0.00	0.00	0.00
	SUM	0.00	0.00	0.00	0.00	0.00
1975	MALE	94.94	0.00	0.00	0.00	94.94
	FEMALE	5.06	0.00	0.00	0.00	5.06
	SUM	100.00	0.00	0.00	0.00	100.00
1976	MALE	36.68	27.22	0.00	0.00	63.90
	FEMALE	1.15	34.95	0.00	0.00	36.10
	SUM	37.83	62.17	0.00	0.00	100.00
1977	MALE	84.60	4.03	0.47	0.00	89.10
	FEMALE	5.32	3.20	2.38	0.00	10.90
	SUM	89.92	7.23	2.85	0.00	100.00
1978	MALE	22.65	17.21	0.60	0.00	40.46
	FEMALE	2.54	55.44	1.56	0.00	59.54
	SUM	25.19	72.65	2.16	0.00	100.00
1979	MALE	73.50	4.61	0.24	0.00	78.35
	FEMALE	6.88	9.67	5.10	0.00	21.65
	SUM	80.38	14.28	5.34	0.00	100.00
1980	MALE	36.17	27.18	0.18	0.00	63.53
	FEMALE	2.06	31.39	2.92	0.10	36.47
	SUM	38.23	58.57	3.10	0.10	100.00
1981	MALE	65.33	4.54	1.15	0.00	71.02
	FEMALE	5.63	18.47	4.88	0.00	28.98
	SUM	70.96	23.01	6.03	0.00	100.00
TOTAL	MALE	57.93	12.45	0.39	0.00	70.78
	FEMALE	4.44	21.50	3.25	0.03	29.22
	SUM	62.37	33.95	3.64	0.03	100.00

Table 5A. Deduced escapement to Robertson Creek Hatchery, based on recovered marks and brailer returns. These are obtained from actual brailer counts of jacks, adult males, and adults females. The age distribution of adult males and females, regarded as distinct groups, comes from Table 4C.

YEAR	SEX	JACKS	3 YRS.	4 YRS.	5 YRS.	6 YRS.	T.ADULTS	TOTAL
1974	MALE	1858	0	0	0	0	0	1858
	FEMALE	0	0	0	0	0	0	0
	SUM	1858	0	0	0	0	0	1858
1975	MALE	828	1099	0	0	0	1099	1927
	FEMALE	0	26	0	0	0	26	26
	SUM	828	1125	0	0	0	1125	1953
1976	MALE	9538	684	508	0	0	1192	10730
	FEMALE	0	32	999	0	0	1031	1031
	SUM	9538	716	1507	0	0	2223	11761
1977	MALE	2971	21038	1006	117	0	22161	25132
	FEMALE	0	1253	753	560	0	2566	2566
	SUM	2971	22291	1759	677	0	24727	27698
1978	MALE	6448	2671	2029	70	0	4770	11218
	FEMALE	0	393	8588	244	0	9225	9225
	SUM	6448	3064	10617	314	0	13995	20443
1979	MALE	15395	15441	968	53	0	16462	31857
	FEMALE	0	1463	2058	1086	0	4607	4607
	SUM	15395	16904	3026	1139	0	21069	36464
1980	MALE	13775	6702	5036	36	0	11774	25549
	FEMALE	0	493	7533	701	24	8751	8751
	SUM	13775	7195	12569	737	24	20525	34300
1981	MALE	10359	13319	926	235	0	14480	24839
	FEMALE	0	598	1965	519	0	3082	3082
	SUM	10359	13917	2891	754	0	17562	27921
TOTAL	MALE	61172	60954	10473	511	0	71938	133110
	FEMALE	0	4258	21896	3110	24	29288	29288
	SUM	61172	65212	32369	3621	24	101226	162398

Table 5B. Age and sex distribution of Robertson Creek Hatchery escapement, based on recovered marks and brailer counts. These are calculated directly from Table 5A.

YEAR	SEX	JACKS	3 YRS.	4 YRS.	5 YRS.	6 YRS.	T.ADULTS	TOTAL
1974	MALE	100.00	0.00	0.00	0.00	0.00	0.00	100.00
	FEMALE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SUM	100.00	0.00	0.00	0.00	0.00	0.00	100.00
1975	MALE	42.40	56.27	0.00	0.00	0.00	56.27	98.67
	FEMALE	0.00	1.33	0.00	0.00	0.00	1.33	1.33
	SUM	42.40	57.60	0.00	0.00	0.00	57.60	100.00
1976	MALE	81.10	5.82	4.32	0.00	0.00	10.14	91.24
	FEMALE	0.00	0.28	8.48	0.00	0.00	8.76	8.76
	SUM	81.10	6.10	12.80	0.00	0.00	18.90	100.00
1977	MALE	10.73	75.96	3.62	0.43	0.00	80.01	90.74
	FEMALE	0.00	4.53	2.72	2.01	0.00	9.26	9.26
	SUM	10.73	80.49	6.34	2.44	0.00	89.27	100.00
1978	MALE	31.54	13.07	9.93	0.35	0.00	23.35	54.89
	FEMALE	0.00	1.92	42.01	1.18	0.00	45.11	45.11
	SUM	31.54	14.99	51.94	1.53	0.00	68.46	100.00
1979	MALE	42.22	42.35	2.66	0.14	0.00	45.15	87.37
	FEMALE	0.00	4.01	5.64	2.98	0.00	12.63	12.63
	SUM	42.22	46.36	8.30	3.12	0.00	57.78	100.00
1980	MALE	40.16	19.54	14.68	0.10	0.00	34.32	74.48
	FEMALE	0.00	1.44	21.96	2.05	0.07	25.52	25.52
	SUM	40.16	20.98	36.64	2.15	0.07	59.84	100.00
1981	MALE	37.10	47.70	3.32	0.83	0.00	51.85	88.95
	FEMALE	0.00	2.14	7.04	1.87	0.00	11.05	11.05
	SUM	37.10	49.84	10.36	2.70	0.00	62.90	100.00
TOTAL	MALE	37.67	37.53	6.45	0.31	0.00	44.30	81.97
	FEMALE	0.00	2.62	13.48	1.92	0.01	18.03	18.03
	SUM	37.67	40.16	19.93	2.23	0.01	62.33	100.00

Table 5C. Age and sex distribution of Robertson Creek Hatchery adult escapement, based on recovered marks and brailer counts. These are calculated from Table 5A, excluding jacks.

YEAR	SEX	3 YRS.	4 YRS.	5 YRS.	6 YRS.	T.ADULTS
1974	MALE	0.00	0.00	0.00	0.00	0.00
	FEMALE	0.00	0.00	0.00	0.00	0.00
	SUM	0.00	0.00	0.00	0.00	0.00
1975	MALE	97.69	0.00	0.00	0.00	97.69
	FEMALE	2.31	0.00	0.00	0.00	2.31
	SUM	100.00	0.00	0.00	0.00	100.00
1976	MALE	30.81	22.86	0.00	0.00	53.67
	FEMALE	1.48	44.85	0.00	0.00	46.33
	SUM	32.29	67.71	0.00	0.00	100.00
1977	MALE	85.08	4.06	0.48	0.00	89.62
	FEMALE	5.07	3.05	2.26	0.00	10.38
	SUM	90.15	7.11	2.74	0.00	100.00
1978	MALE	19.09	14.51	0.50	0.00	34.10
	FEMALE	2.81	61.37	1.72	0.00	65.90
	SUM	21.90	75.88	2.22	0.00	100.00
1979	MALE	73.29	4.60	0.24	0.00	78.13
	FEMALE	6.95	9.77	5.15	0.00	21.87
	SUM	80.24	14.37	5.39	0.00	100.00
1980	MALE	32.66	24.54	0.16	0.00	57.36
	FEMALE	2.40	36.71	3.41	0.12	42.64
	SUM	35.06	61.25	3.57	0.12	100.00
1981	MALE	75.84	5.27	1.32	0.00	82.43
	FEMALE	3.41	11.19	2.97	0.00	17.57
	SUM	79.25	16.46	4.29	0.00	100.00
TOTAL	MALE	60.22	10.35	0.50	0.00	71.07
	FEMALE	4.21	21.63	3.07	0.02	28.93
	SUM	64.42	31.98	3.58	0.02	100.00

Table 6. A comparison between actual returns to Robertson Creek Hatchery and predicted returns based on recovered marks.

YEAR		JACKS	MALES	FEMALES	T.ADULTS	TOTAL
1974	PREDICTED	901	0	0	0	901
	ACTUAL	1858	0	0	0	1858
	% EXPLAIN	48.49	-	-	-	48.49
1975	PREDICTED	451	788	42	830	1281
	ACTUAL	828	1099	26	1125	1953
	% EXPLAIN	54.47	71.70	161.54	73.78	65.59
1976	PREDICTED	5313	1108	626	1734	7047
	ACTUAL	9538	1192	1031	2223	11761
	% EXPLAIN	55.70	92.95	60.72	78.00	59.92
1977	PREDICTED	1747	11845	1448	13293	15040
	ACTUAL	2971	22161	2566	24727	27698
	% EXPLAIN	58.80	53.45	56.43	53.76	54.30
1978	PREDICTED	4421	3585	5274	8859	13280
	ACTUAL	6448	4770	9225	13995	20443
	% EXPLAIN	68.56	75.16	57.17	63.30	64.96
1979	PREDICTED	9970	13294	3674	16968	26938
	ACTUAL	15395	16462	4607	21069	36464
	% EXPLAIN	64.76	80.76	79.75	80.54	73.88
1980	PREDICTED	5696	9917	5692	15609	21305
	ACTUAL	13775	11774	8751	20525	34300
	% EXPLAIN	41.35	84.23	65.04	76.05	62.11
1981	PREDICTED	3259	3798	1550	5348	8607
	ACTUAL	10359	14480	3082	17562	27921
	% EXPLAIN	31.46	26.23	50.29	30.45	30.83
TOTAL	PREDICTED	31758	44335	18306	62641	94399
	ACTUAL	61172	71938	29288	101226	162398
	% EXPLAIN	51.92	61.63	62.50	61.88	58.13

Table 7. Synopsis of model results with pool time set to 10 days.

	Year						
	76[5]	77[5]	78	79	80	81	"Typical"
Mid-pool peak day[1]			249.5	239.4	242.8	242.7	244
Mid-pool 90% day[2]			269.9	260.0	261.6	260.3	263
Percent of run at peak	49.1	42.9	58.3	43.1	46.9	55.2	50
Test catchability			.00121	.00101	.00121	.00050	.0011
Peak lag time[3]			55.8	65.0	58.4	62.7	60.3
Run compression factor[4]			3.58	1.58	1.72	2.75	2.41
Day of peak escapement	294.3	294.6	300.3	298.4	296.2	300.4	299
Day of 90% escapement	305.3	308.4	306.0	311.4	307.1	306.8	308
Total escapement	2223	33727	21995	24909	24525	24062	
Percent "wild"	0	26.7	36.4	15.4	16.3	27.0	
Total catch	0	0	15886	23691	36947	38081	
Commercial	0	0	9993	12762	26265	27480	
Sport	0	0	4218	6515	5605	3902	
Food	0	0	703	3250	4124	6300	
Test	0	0	972	1164	953	599	
Total run	2223	33727	37881	48600	61472	62143	

[1]Fishery peak day + 1/2 pool time.
[2]Fishery 90% day + 1/2 pool time.
[3]Hatchery peak - fishery peak.
[4](Fishery 90% - fishery peak)/(hatchery 90% - hatchery peak).
[5]Model applied to escapement data only.

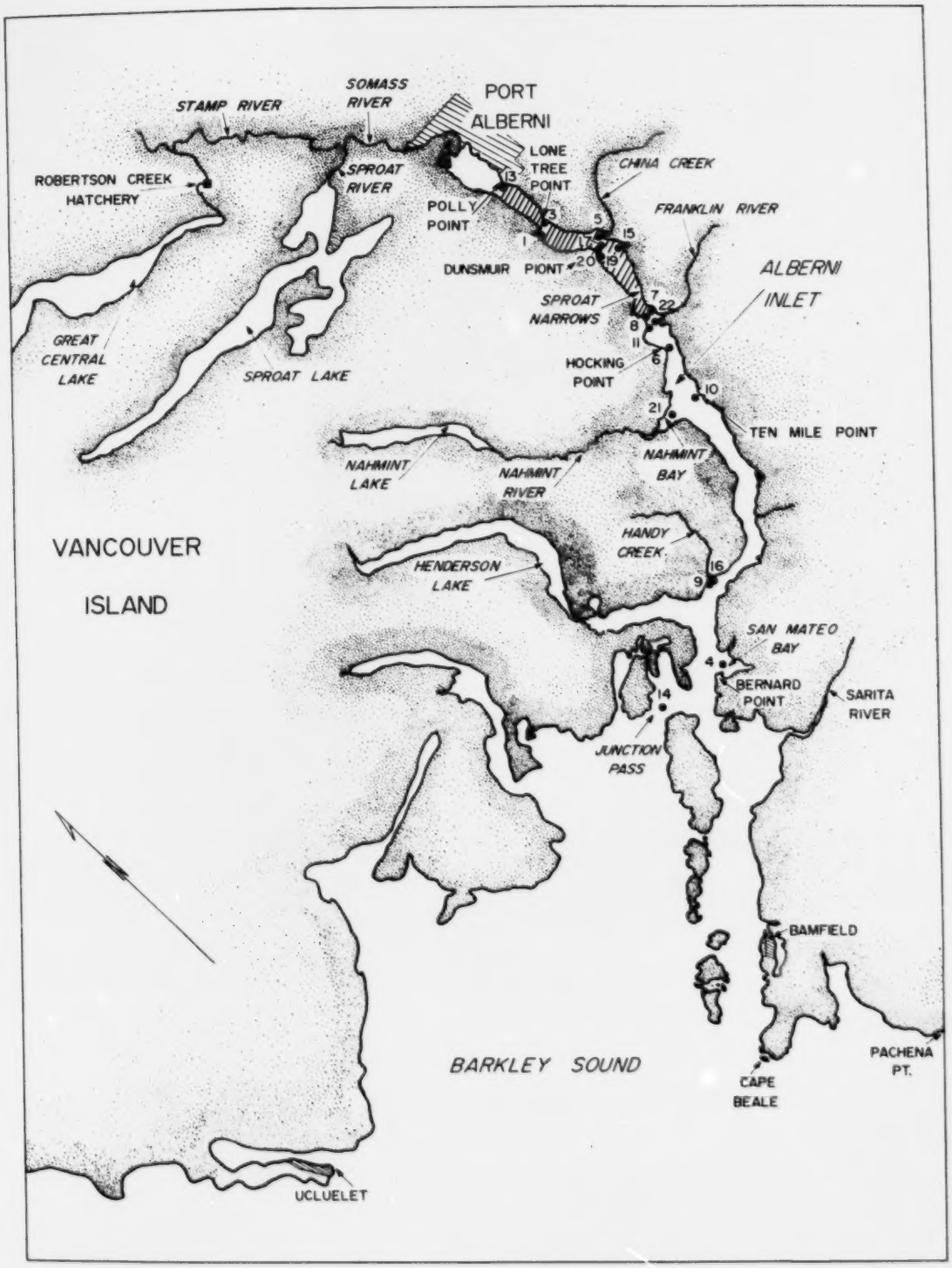

Fig. 1. Map of study area showing test fishery sites (solid circles) and commercial fishing area (shaded).

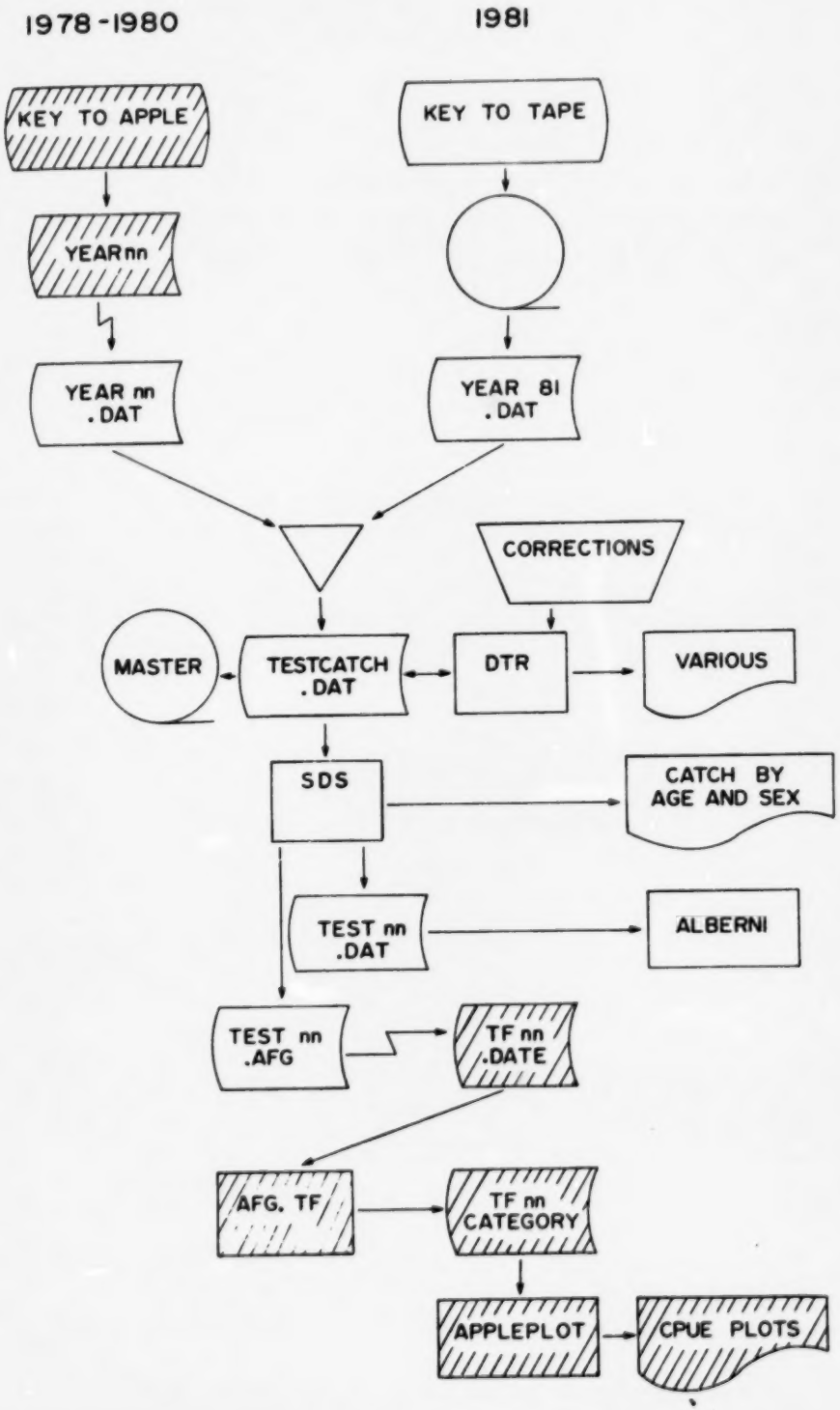

Fig. 2. Flowchart of major data processing steps required for analysis of test fishery data. Shaded boxes indicate processes and files on APPLE computer; open boxes indicate VAX computer.

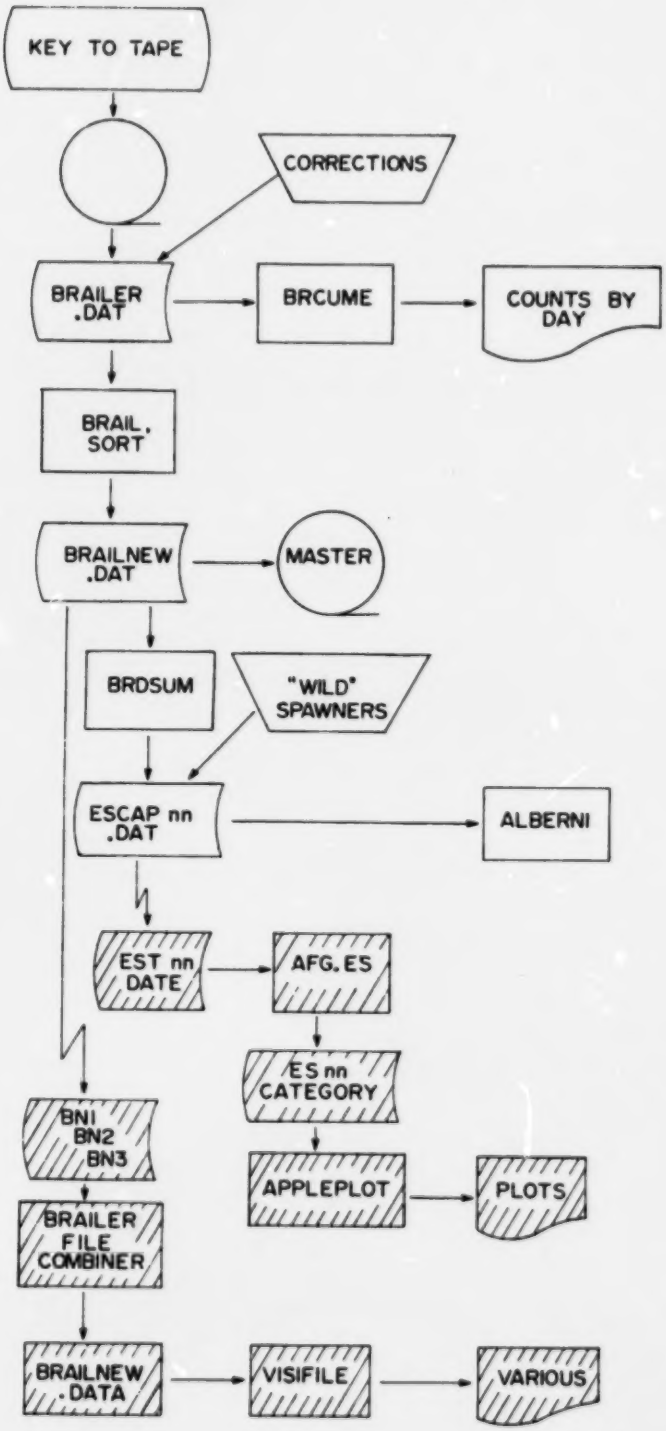

Fig. 3. Flowchart of major data processing steps required for analysis of escapement data. Shaded boxes indicate processes and files on APPLE computer; open boxes indicate VAX computer.

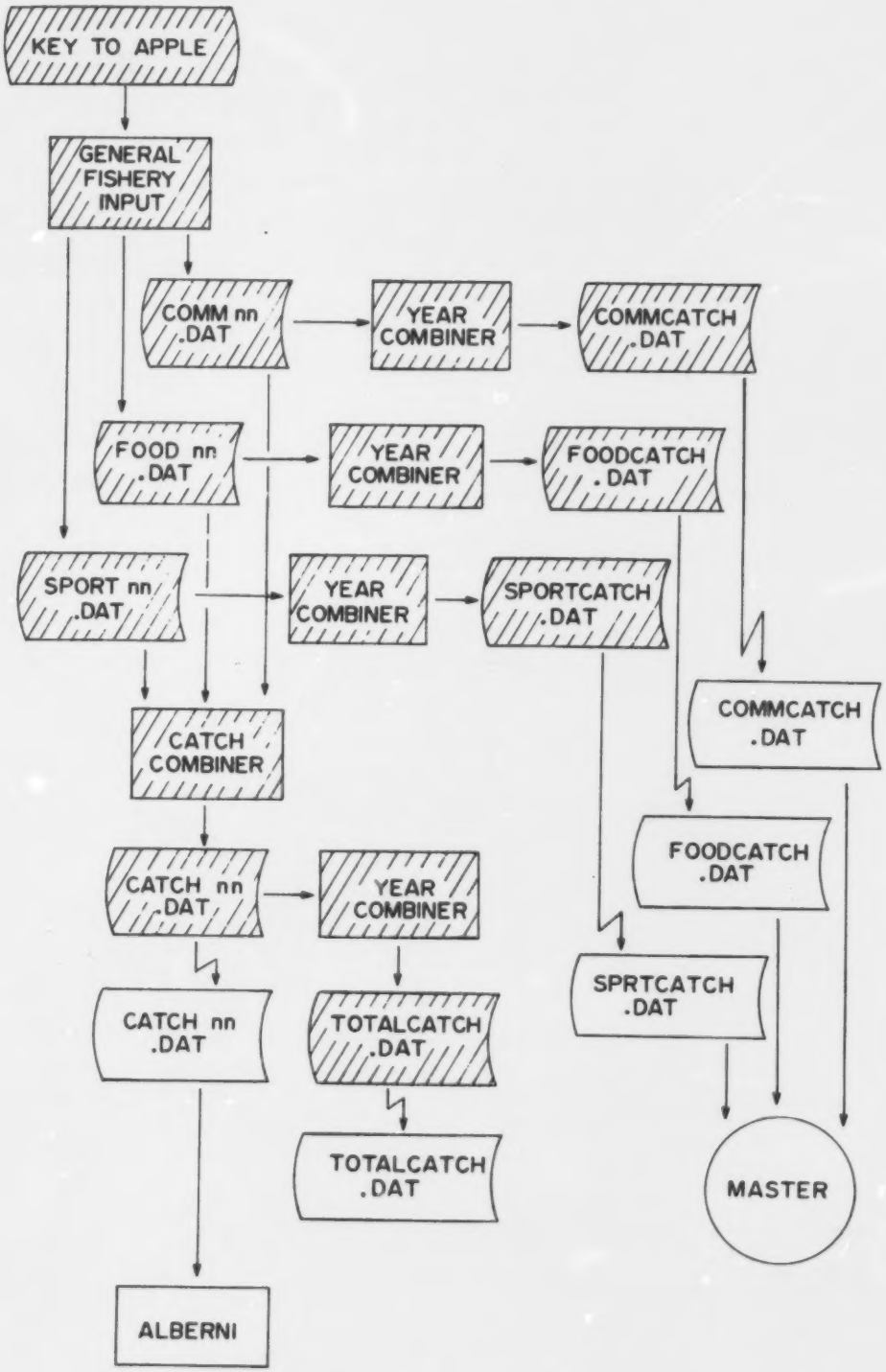

Fig. 4. Flowchart of major data processing steps required for analysis of commercial, native food, and sport fishery data. Shaded boxes indicate processes and files on APPLE computer; open boxes indicate VAX computer.

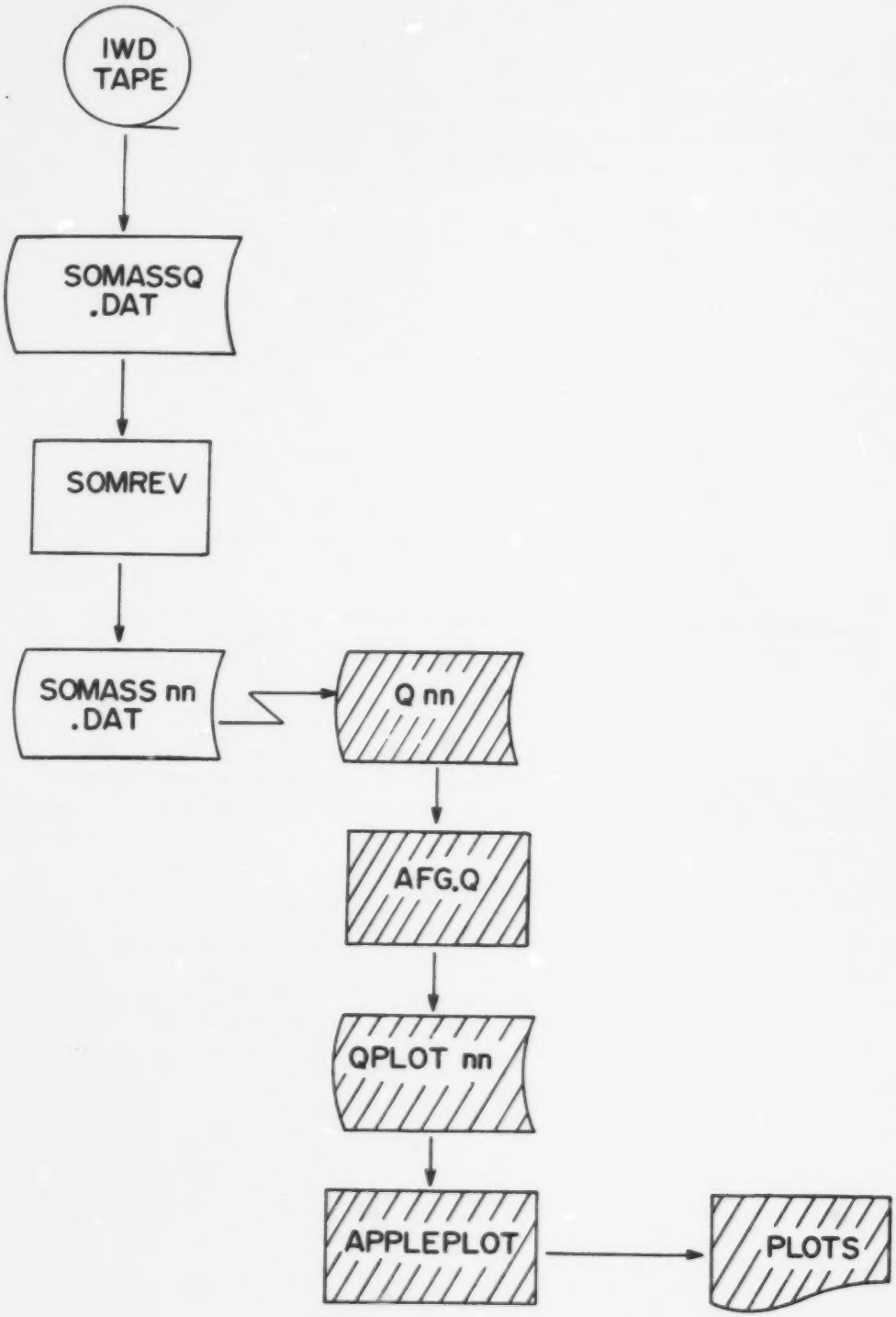

Fig. 5. Flowchart of major data processing steps required for analysis of Somass River discharge data. Shaded boxes indicate processes and files on APPLE computer; open boxes indicate VAX computer.

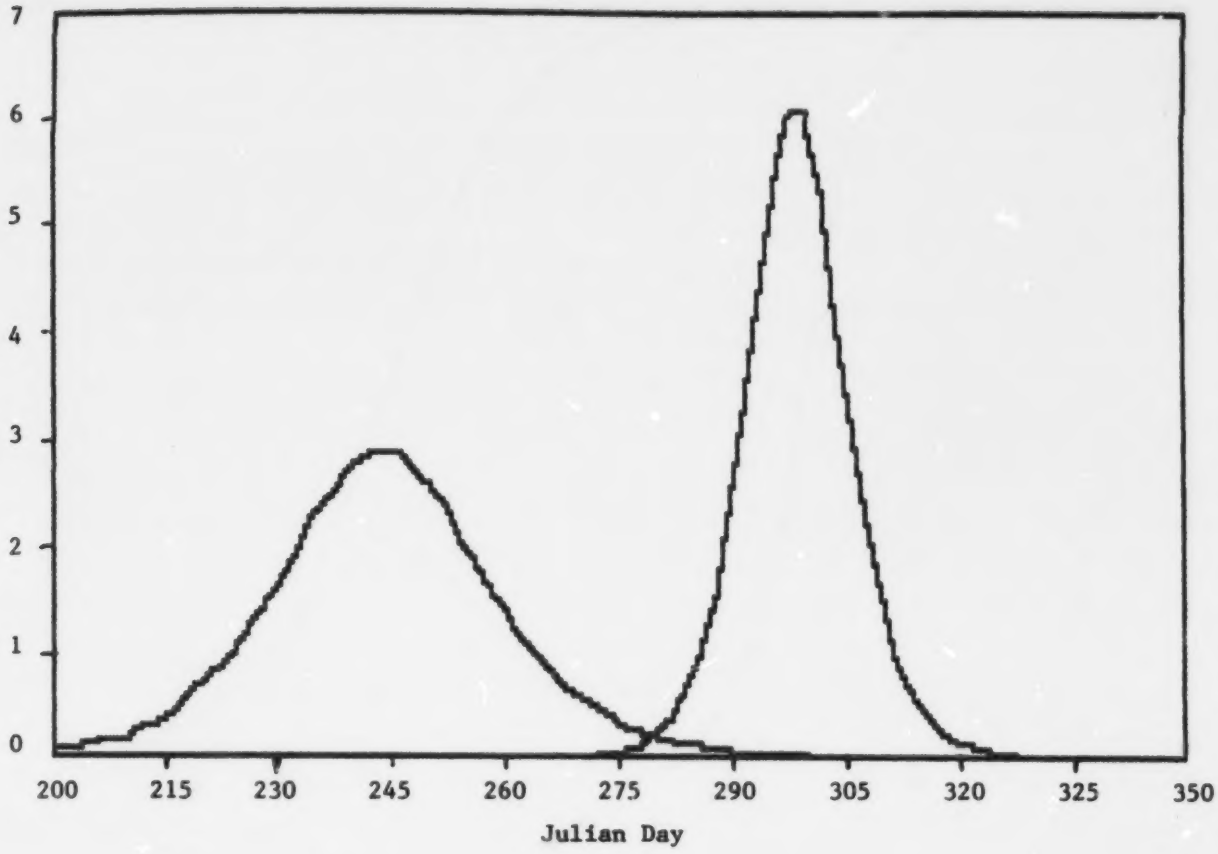

Fig. 6. Predictions of model for a "typical" case using a 10-day pool time and parameters shown in Table 7; daily run to fishery and daily escapement.

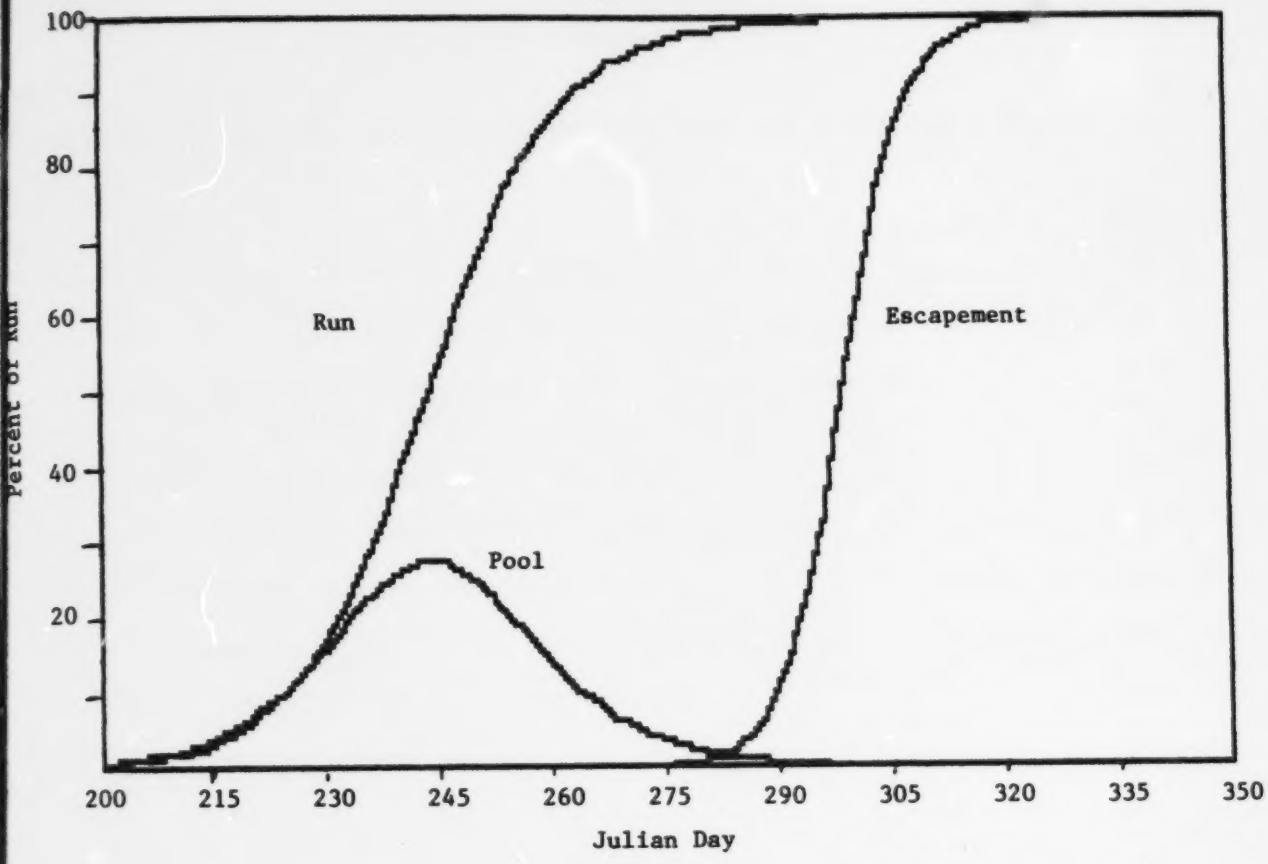

Fig. 7. Predictions of model for a "typical" case using a 10-day pool time and parameters shown in Table 7; cumulative run, pool size, and cumulative escapement.

Appendix A. Documentation of original data files and summary of computer programs.

		Page
Table A1.	Format of test fishery records.	40
Table A2.	DATATREIVE definition for test fishery data base.	41
Table A3.	Codes and valid ranges of values for variables in test fishery data fields.	42
Table A4.	Format of brailer records.	43
Table A5.	Format of commercial gillnet catch records.	44
Table A6.	Format of sport fishery records.	45
Table A7.	Format of native food fishery records.	46
Table A8.	Catalog of APPLE computer programs.	47
Table A9.	Catalog of VAX computer programs.	49

Table A1. Format of test fishery records.

File name: TESTCATCH.DAT.

Synonyms: None.

Contents: Test fishery raw data.

Source: Data entry programs (1978-80) or key to tape (1981).

Format:

Byte	Contents*
1-2	Year-1900
3-4	Month
5-6	Day
7	Set number
8-11	Time in
12-15	Time out
16-17	Tidal stage
18-19	Location
20	Mesh
21-22	Cloud cover
23	Rain
24	Moon
25-26	Wind speed
27-28	Wind direction
29	Species code
30-32	Scale book number
33-34	Scale number
35	Sex
36-39	Length
40-41	Age code
42	Origin
43-48	Wire tag code
49-50	Brood year

*See Table A3 for code definitions.

Table A2. DATATREIVE definition for test fishery data.

```
DELETE ATF;
DELETE ATF-REC;
DEFINE DOMAIN ATF USING ATF-REC
   ON TESTCATCH;
DEFINE RECORD ATF-REC USING
01 ATF-REC.
15 YEAR                PIC IS X(2)          EDIT-STRING IS Z(2).
15 MON                 PIC IS X(2)          EDIT-STRING IS Z(2).
15 DAY                 PIC IS X(2)          EDIT-STRING IS Z(2).
15 SET-NUM             PIC IS X(1)          EDIT-STRING IS 9(1).
15 TIME-IN             PIC IS X(4)          EDIT-STRING IS Z(4).
   QUERY-NAME IS TIN.
15 TIME-OUT            PIC IS X(4)          EDIT-STRING IS Z(4).
   QUERY-NAME IS TOUT.
15 TID-STG             PIC IS X(2).
15 LOC                 PIC IS X(2)          EDIT-STRING IS Z(2).
15 MESH                PIC IS X(1)          EDIT-STRING IS 9(1).
15 CVR                 PIC IS X(2)          EDIT-STRING IS Z(2).
15 RA-IN               PIC IS X(1)          EDIT-STRING IS 9(1).
15 MO-ON               PIC IS X(1)          EDIT-STRING IS 9(1).
15 WSP                 PIC IS X(2)          EDIT-STRING IS Z(2).
15 WDR                 PIC IS X(2).
15 SPP                 PIC IS X(1)          EDIT-STRING IS 9(1).
15 SBN                 PIC IS X(3)          EDIT-STRING IS Z(3).
15 SCL-NUM             PIC IS X(2)          EDIT-STRING IS Z(2).
15 SEX                 PIC IS X(1).
15 LENGTH              PIC IS X(4)          EDIT-STRING IS Z(4).
15 SCL-AGE             PIC IS X(2)          EDIT-STRING IS 9(2)
   QUERY-NAME IS SAGE.
15 SCALE-ORIGIN        PIC IS X(1)
   QUERY-NAME IS SORG.
15 CWT-CODE            PIC IS X(6)
   QUERY-NAME IS CWT.
15 BRD-YR              PIC IS X(2)          EDIT-STRING IS Z(2)
   QUERY-NAME IS BYR.
```

Table A3. Codes and valid ranges for TESTCATCH fields.

Field	Values
1 Year	78, 79, 80, 81
2 Month	1, ... , 12
3 Day	1, ... , 31
4 Set number	1, ... , 5
5 Time in	0, ... , 2400; 9999 = no data
6 Time out	0, ... , 2400; 9999 = no data
7 Tidal stage	LS = low slack
	HS = high slack
	EB = ebb
	FL = flood
	XX = no data
8 Location	0, ... , 23; 99 = no data
9 Mesh	0 = no data
	1 = 5 1/4; 2 = 5 7/8; 3 = 6 1/4
	4 = 7"; 5 = 8 1/8; 6 = unknown
	7 = 7 1/2 or 7 1/4; 8 = 8; 9 = 6 1/2
10 Cloud cover	0 = 10 tenths cover; 99 = no data
11 Rain	0 = no rain
	1 = light
	2 = medium
	3 = heavy
	4 = no data
12 Moon	0 = no data
	1 = new
	2 = first quarter
	3 = full
	4 = last quarter
13 Wind speed	0, ... , 99; 99 = no data
14 Wind direction	N, E, S, W, NE, SE, SW, NW; XX = no data
15	0 = unknown; 1 = sockeye; 2 = chinook
	3 = coho; 4 = pink; 5 = chum
	6 = steelhead
16 Scale book number	1 - 150
17 Scale number	1 - 10
18 Sex	M = male; F = female; X = unknown
19 Length	in millimeters
20 Age	21 - 62
	80 = scale missing
	90 = regenerate
21 Origin	W = wild; H = hatchery; U = unknown
22 Wire tag codes	6 digits
23	72 - 79

Table A4. Format of brailer records.

File name: BRAILNEW.DAT.

Synonyms: BRAILNEW.DATA for APPLE VISIFILE version.

Contents: Merged version of brailer record from Robertson Creek Hatchery containing a code for marked and unmarked fish.

Source: Output from program BRAIL.

Format:

Byte	Contents
1-2	Year-1900 (73, . . . , 81)
3-4	Month (01, . . . , 12)
5-6	Day
7	0 for unmarked fish; 1 for marked
8-12	Chinook jacks
13-17	Chinook adult males
18-22	Chinook females
23-27	Coho jacks
28-32	Coho adults
33-37	Steelhead
38-42	Sockeye

Table A5. Format of commercial catch records.

File name: COMMCATCH.DAT.

Synonyms: None.

Contents: Commercial catch of chinooks from Alberni Inlet.

Source: Output from YEAR COMBINER (APPLE).

Format:

Byte	Contents
1-2	Year-1900 (78, . . . , 81)
3-5	Julian day
6-8	Days fishery open (usually 1)
9-12	Number of nets fished
13-18	Total catch (jacks and adults)
19-24	Jacks
25-30	Adults

Table A6. Format of sport fishery records.

Name: SPRTCATCH.DAT.

Synonym: SPORTCATCH.DAT (APPLE).

Contents: Sport catch of chinooks in area 23 by week*.

Source: YEAR COMBINER (APPLE).

Byte	Contents
1-2	Year-1900 (78, . . . , 81)
3-5	Julian day of "week" start
6-8	Number of days in "week"
9-12	Not used (set to 1)
13-18	Total catch (jacks and adults)
19-24	Jacks
25-30	Adults

*Week used to indicate a reporting period of approximately 7 days.

Table A7. Format of food fishery records.

Name: FOODCATCH.DAT.

Synonyms: None.

Contents: Chinook catch by native food fishery in Somass River by week.

Source: Output from YEAR COMBINER (APPLE).

Format:

Byte	Contents
1-2	Year-1900 (78, . . . , 81)
3-5	Julian day of opening
6-8	Days open
9-12	Number of nets
13-18	Total catch (jacks and adults)
19-24	Jacks
25-30	Adults

Table A8. Catalogue of APPLE programs. Starred programs shown in flowcharts.

Name	Input	Output	Function
*AFG.ES	ESnn.DAT	ESnn category	Generates APPLEPLOT files for year 19nn escapement
*AFG.Q	MM.Qnn	QPLOT nn	Generates APPLEPLOT files for year 19nn discharge
*AFG.TF	TFnn.DATE	TFnn category	Generates APPLEPLOT files for year 19nn test fishery
*APPLEPLOT[1]	various	graphics	Commercial plotting utility.
*BRAILER FILE COMBINER	MM.BN1, MM.BN2, MM.BN3.	BRAILER.DATA	Combines segments of BRAILNEW.DAT and converts to VISIFILE[3] format.
*CATCH COMBINER	COMMnn.DAT SPORTnn.DAT FOODnn.DAT	CATCHnn.DAT	Calculates total catch (commercial + sport + food) by day.
CDMA	YEARnn	YEARnn.DAT	Transfers file in DMS format to VAX; used for test fishery files.
TMAR	YEARnn	Screen	View selected records in DMS file; used for test fishery files.
*GENFI	Keyboard	COMMnn.DAT SPORTnn.DAT FOODnn.DAT	Input program for commercial, sport, and native food fishery results for year 19nn.
*RECORD COMBINER	any	any	Combine successive records of one file into a single record in another file.
RUN FRACTIONS	TFnn.DATE ESnn.DATE	Printer	Calculates times to arbitrary cumulative fraction of test fishery and brailer returns.
SDS	YEARnn	TFnn.SET TFnn.DATE	SEt and date summarizer for 19nn test fishery.
SDS.MOD	YEARnn	TFnn.MOD.DATE TFnn.MOD.SET	Set and data summarizer for 19nn test fishery for ALBERNI input. (=TESTnn.DAT).

Table A8. (cont'd)

Name	Input	Output	Function
*TFI[2]	Keyboard	YEARnn	Input program for year 19nn test fishery data.
*VISIFILE[3]	Various	Various	Commercial data base management utility.
*YEAR COMBINER	COMMnn.DAT SPORTnn.DAT FOODnn.DAT CATCHnn.DAT	COMMCATCH.DAT SPRTCATCH.DAT FOODCATCH.DAT TOTALCATCH.DAT	Combines yearly catch files into single file.

[1] Copywrite APPLE Computer Inc., 1980.
[2] Lee and Associates, 1981.
[3] Copywrite Personal Software, Inc., 1981.

Table A9. Catalog of VAX programs. Starred programs shown in flowcharts.

Name	Input	Output	Function
*BRAIL	BRAILER.DAT	BRAILNEW.DAT	Change format of brailer record
*BRCUME	BRAILER.DAT	FOR006 Printer	Calculate cumulative brailer returns.
*BRDSUM	BRAILNEW.DAT	ESnn.DAT (=ESCAPnn.DAT)	Daily summary of chinook escapement for year 19nn.
*DATATREIVE[1]	Various	Various	Commercial database management utility.
DELNK	YEARnn.DAT	YEARnn.DAT	Deletes blank lines from test fishery data.
DNUM	YEARnn.DAT	YEARnn.DAT	Removes DMS record numbers from test fishery data.
*SDS	TESTCATCH.DAT	TESTnn.DAT TESTnn.APG (=TFnn.DATE) Printer	Set and date summarizer for test fishery file.
*SOMREV	SOMASSQ.DAT	SOMASSnn.DAT	Breaks down discharge file by year
TCR	TESTCATCH.DAT	TESTCATCH.DAT	Right justify integer fields, complete brood year, delete "V" field.
TC81	YEAR81.DAT	YEAR81.DAT	As in TCR; also rearranges date fields for 1981 test fishery data.

[1] Copywrite Digital Equipment Corp.

Appendix B. Summary figures of run timing and Somass River discharge.

		Page
Fig. B1.	Catches of adult males (L) and females (R) in test fishery; 1978-1981. CPUE is in fish per hour.	53
Fig. B2.	Returns (fish per day) of adult males (L) and females (R) to brailer; 1974-1981.	63
Fig. B3.	Commercial gillnet adult catch (L) and test fishery adult catch (R); 1978-1981. Gillnet catch is fish per day; test fishery is fish per hour.	81
Fig. B4.	Returns (fish per day) adults to brailer (L) and Somass River daily discharge (R); 1974-1981. (Discharge data for 1981 not available).	91
Fig. B5.	Returns (fish per day) of jacks to brailer; 1973-1981.	109
Fig. B6.	Catches of jacks in test fishery; 1978-1981. CPUE is in fish per hour.	121
Fig. B7.	Catches of age three fish (L) and age four fish (R) in test fishery 1978-1981. CPUE is in fish per hour.	127

FIG. B1

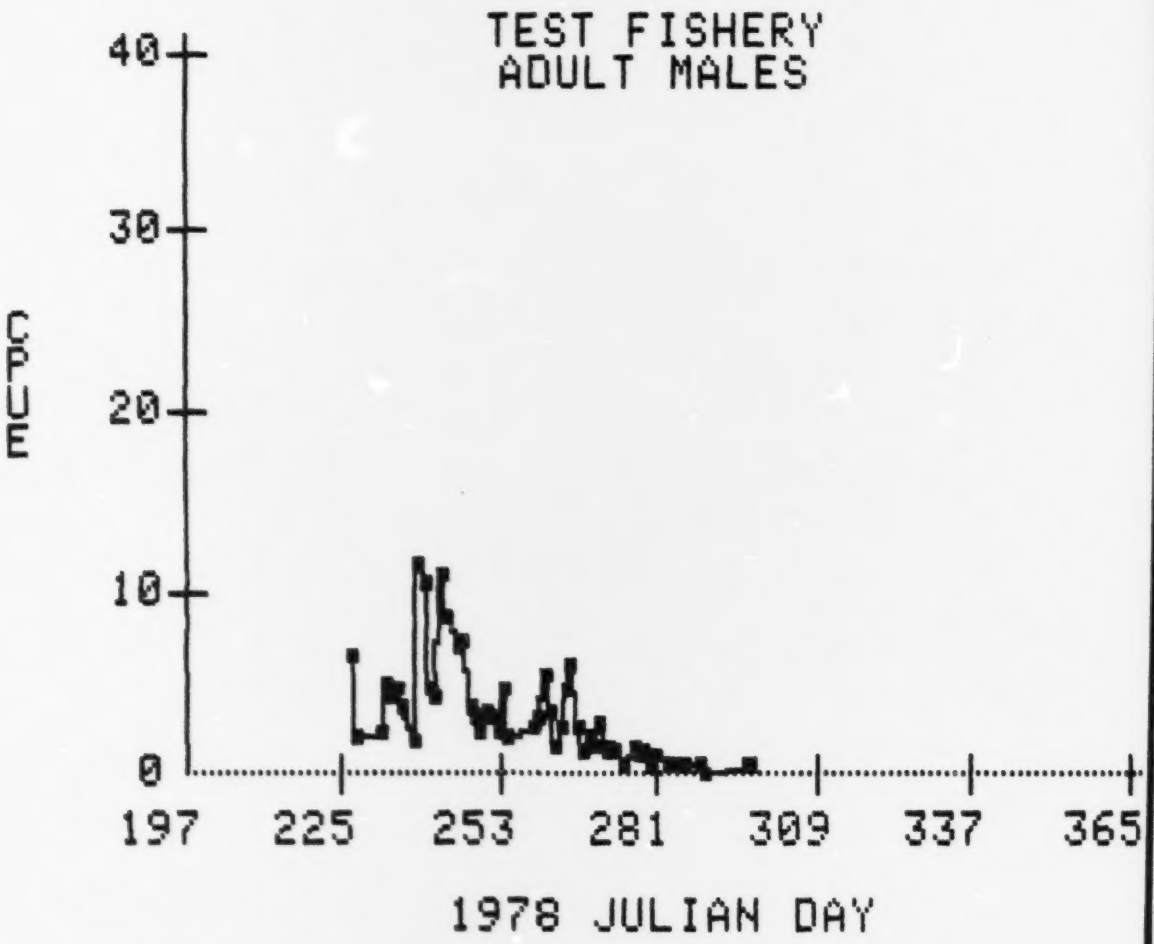

Fig. B1-78-L. Catch of adult males in test fishery 1978. CPUE is in fish per hour.

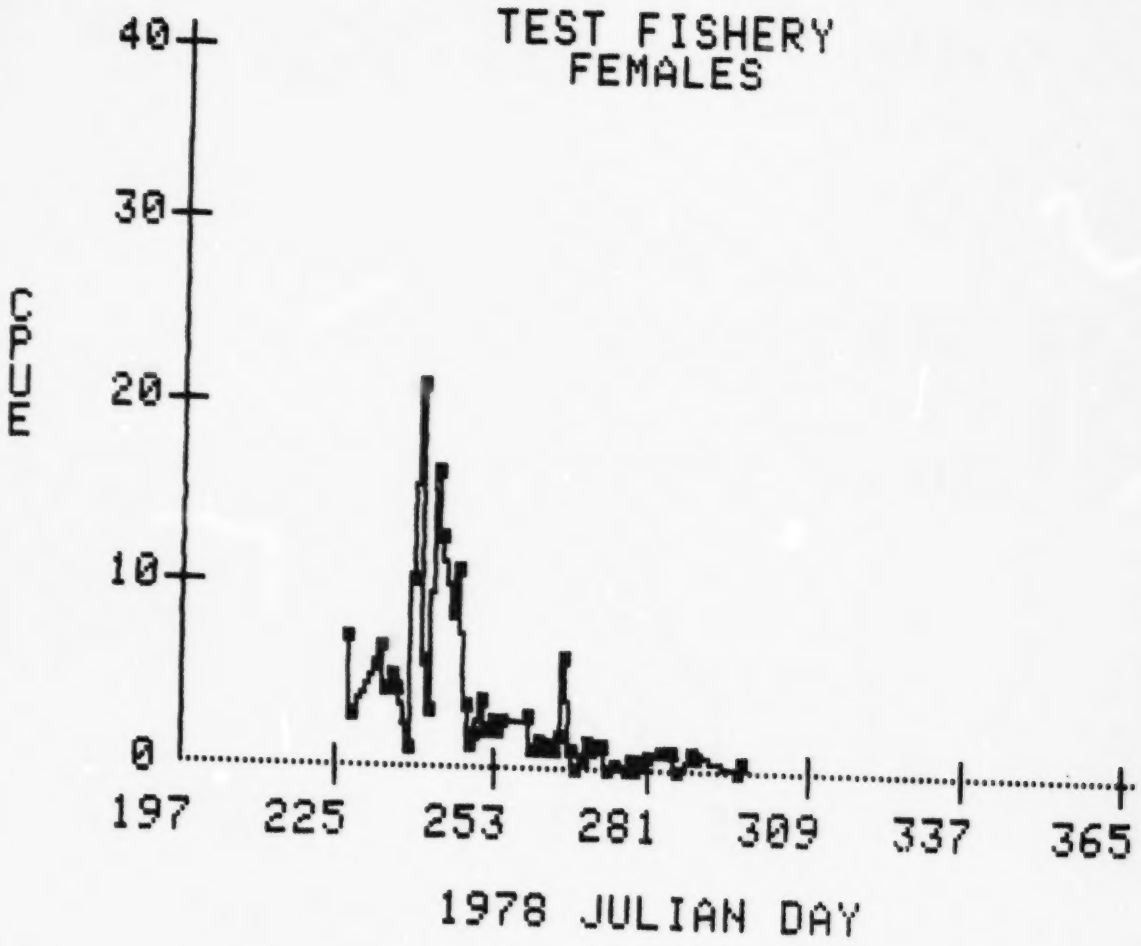

Fig. B1-78-R. Catch of adult females in test fishery 1978. CPUE is in fish per hour.

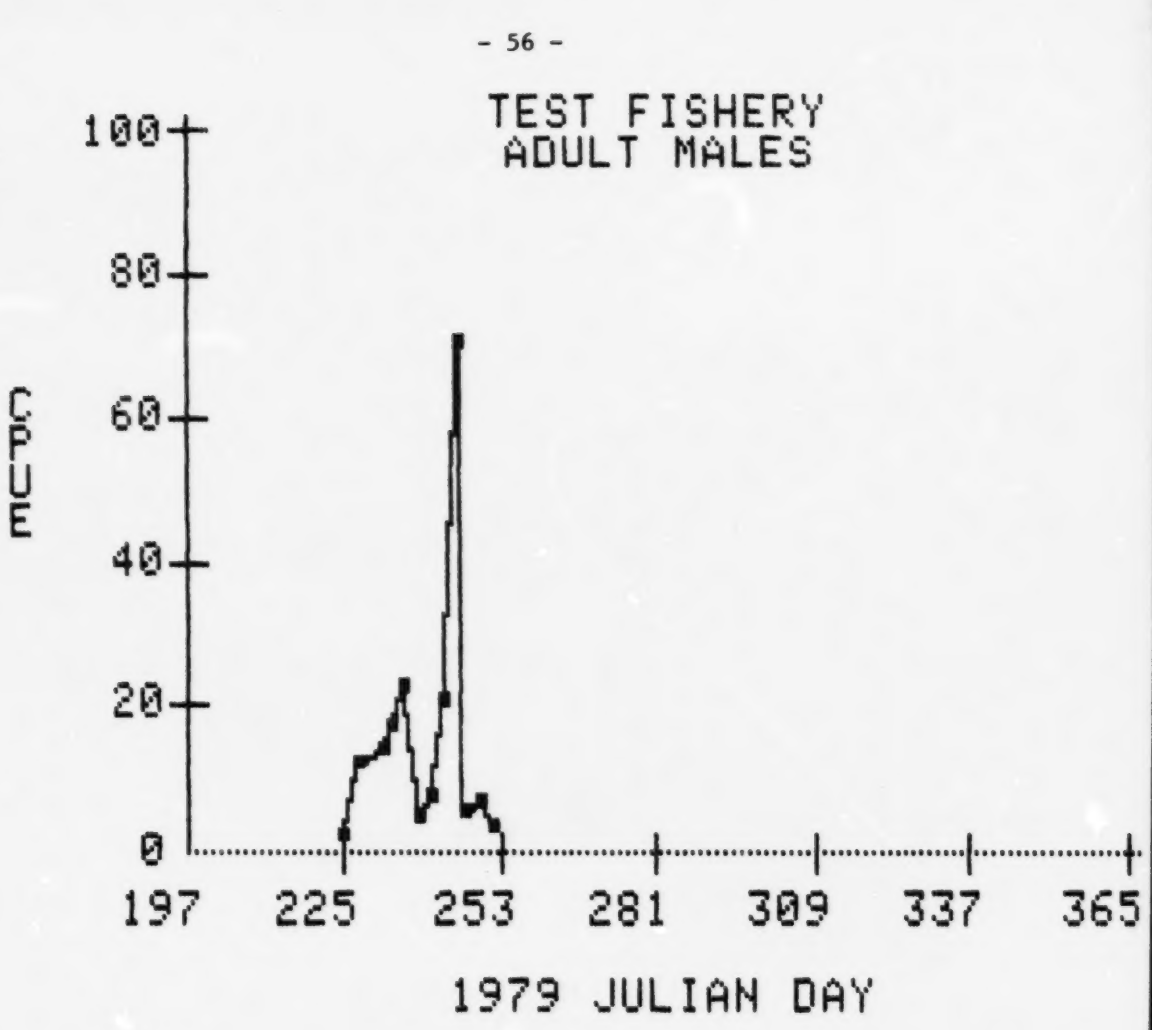

Fig. B1-79-L. Catch of adult males in test fishery 1979. CPUE is in fish per hour.

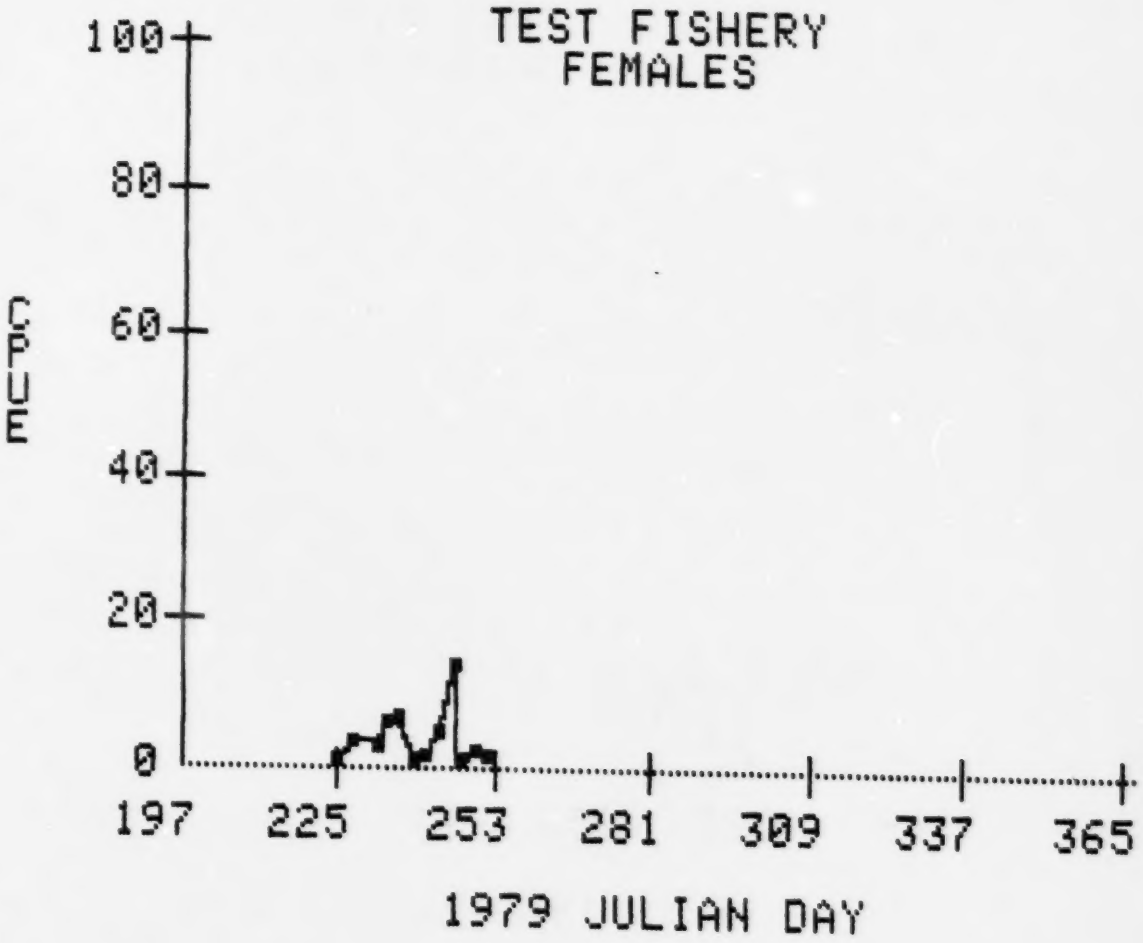

Fig. B1-79-R. Catch of adult females in test fishery 1979. CPUE is in fish per hour.

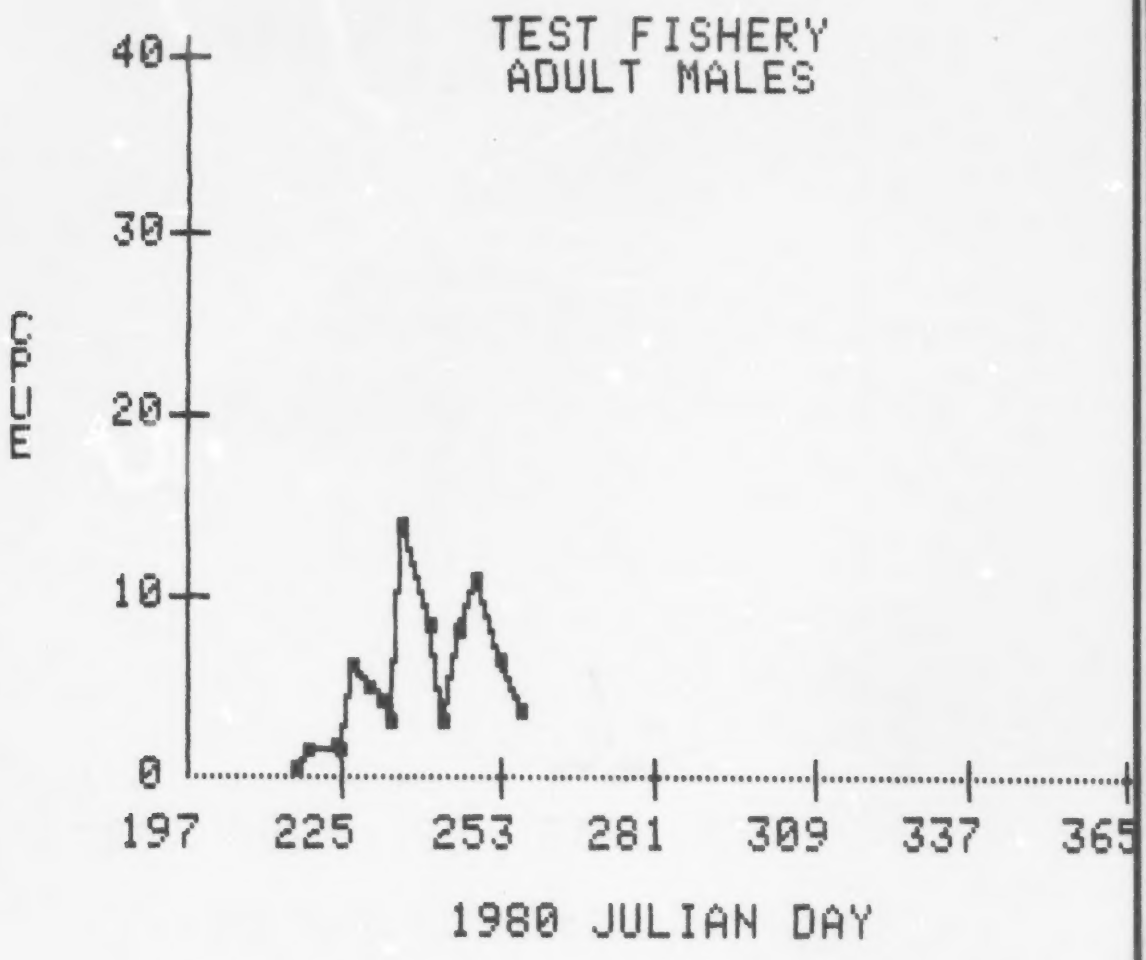

Fig. B1-80-L. Catch of adult males in test fishery 1980. CPUE is in fish per hour.

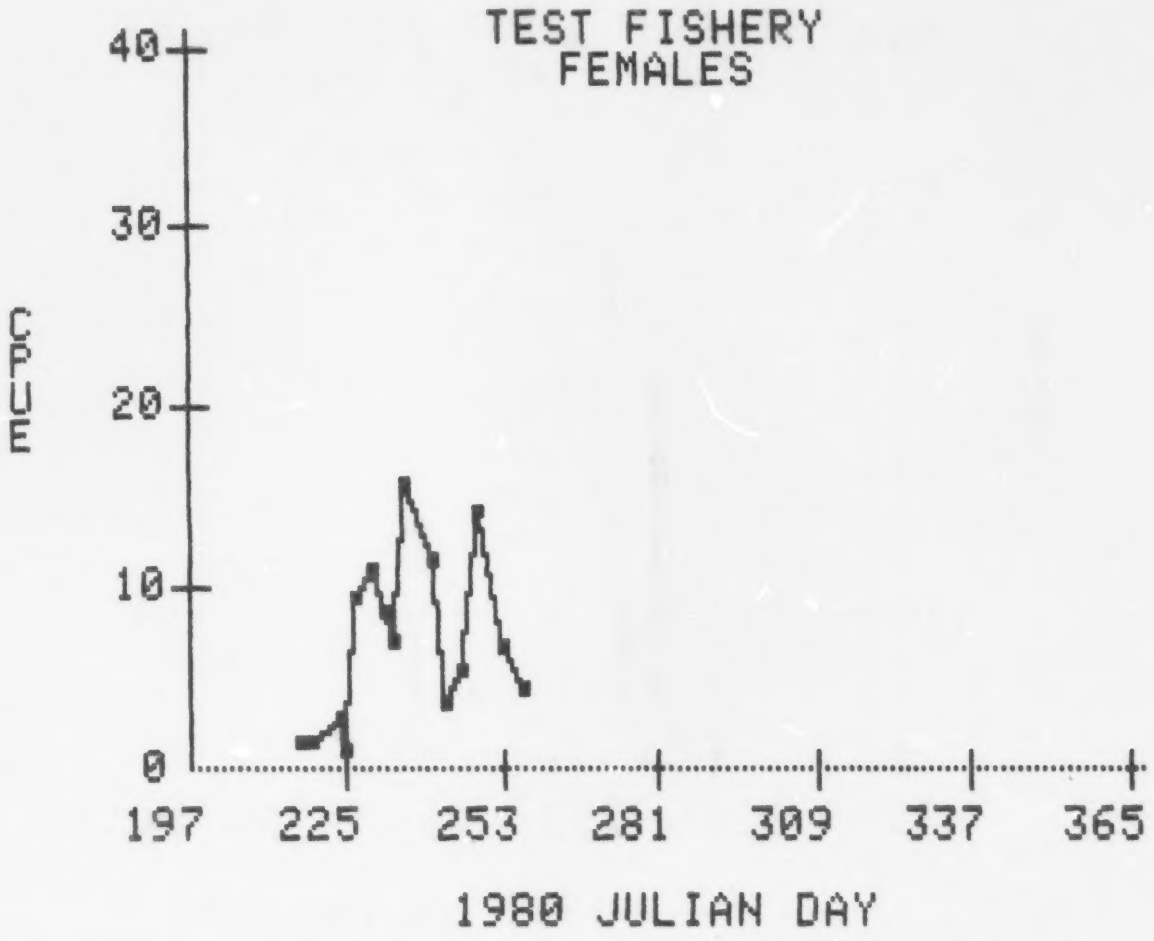

Fig. B1-80-R. Catch of adult females in test fishery 1980. CPUE is in fish per hour.

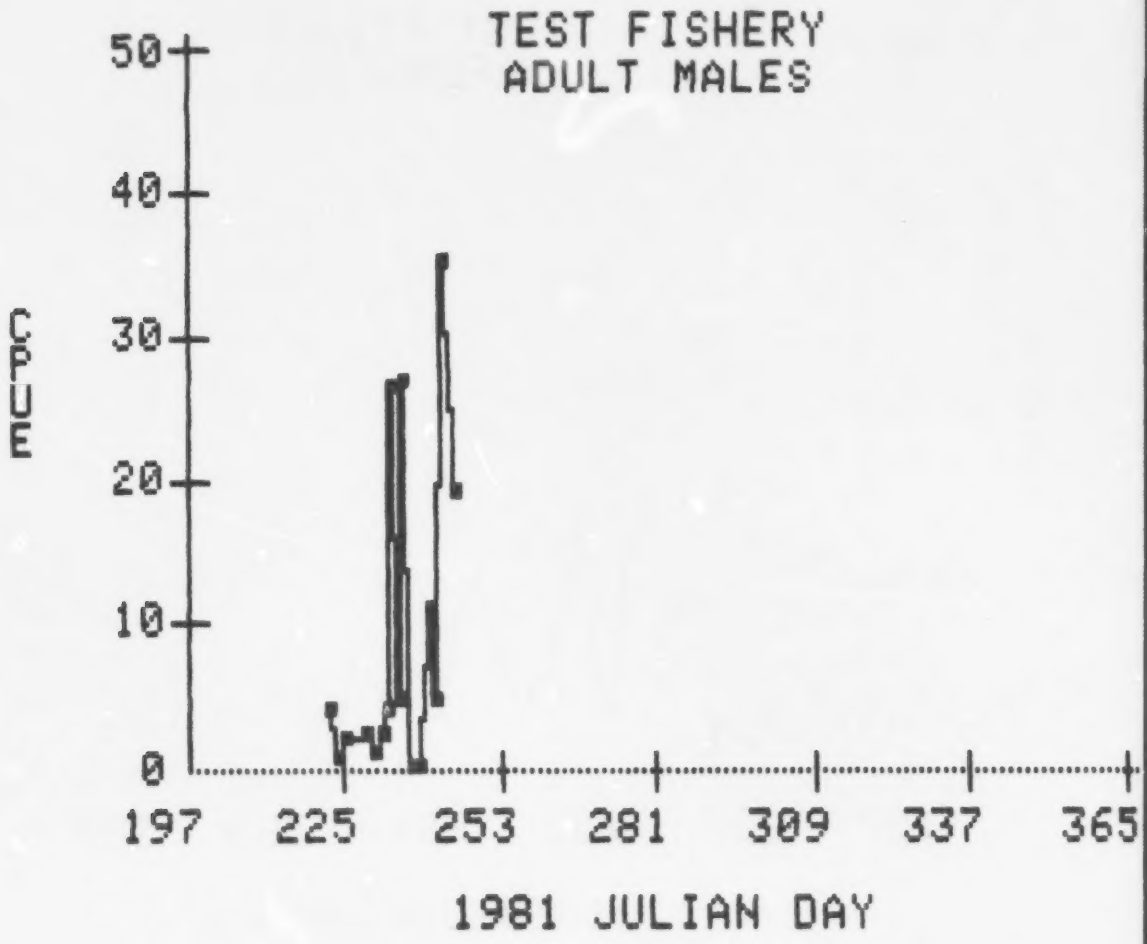

Fig. B1-81-L. Catch of adult males in test fishery 1981. CPUE is in fish per hour.

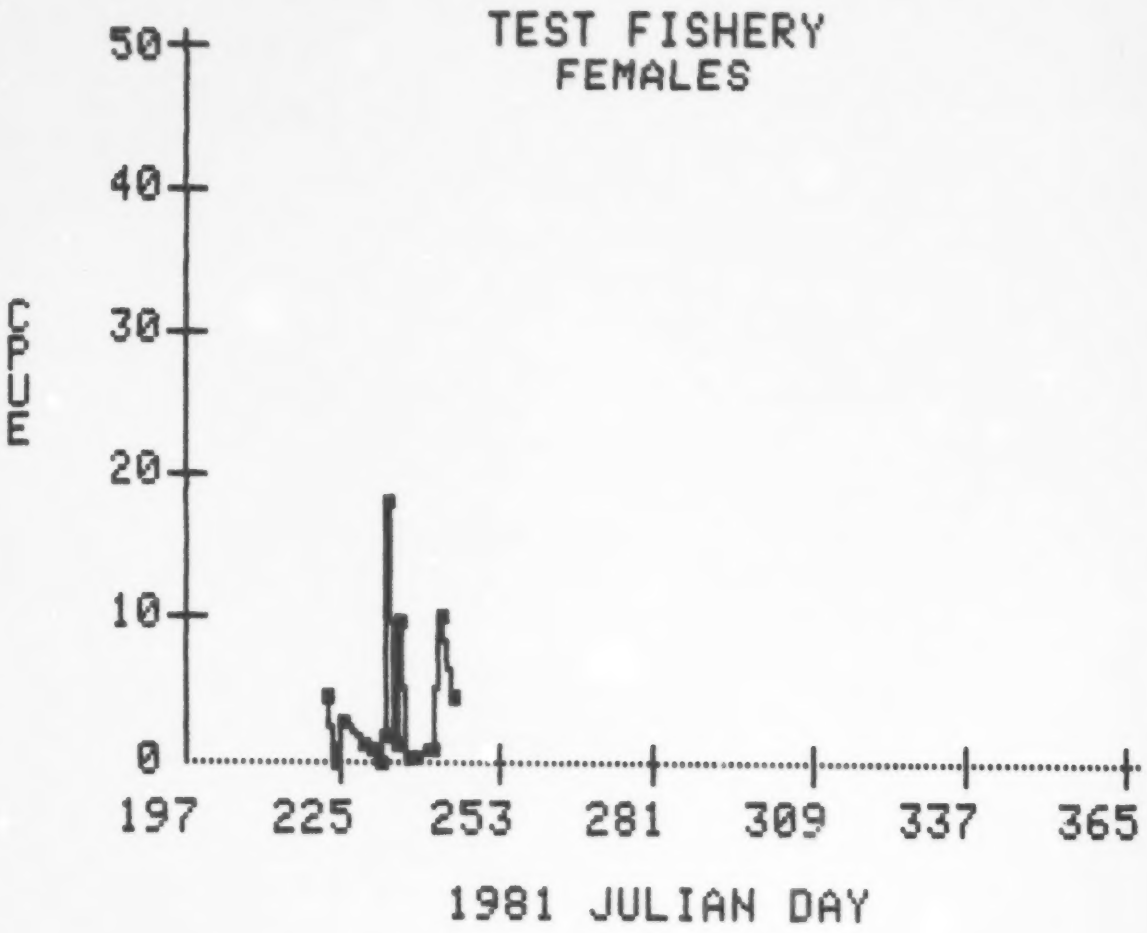

Fig. B1-81-R. Catch of adult females in test fishery 1981. CPUE is in fish per hour.

FIG. B2

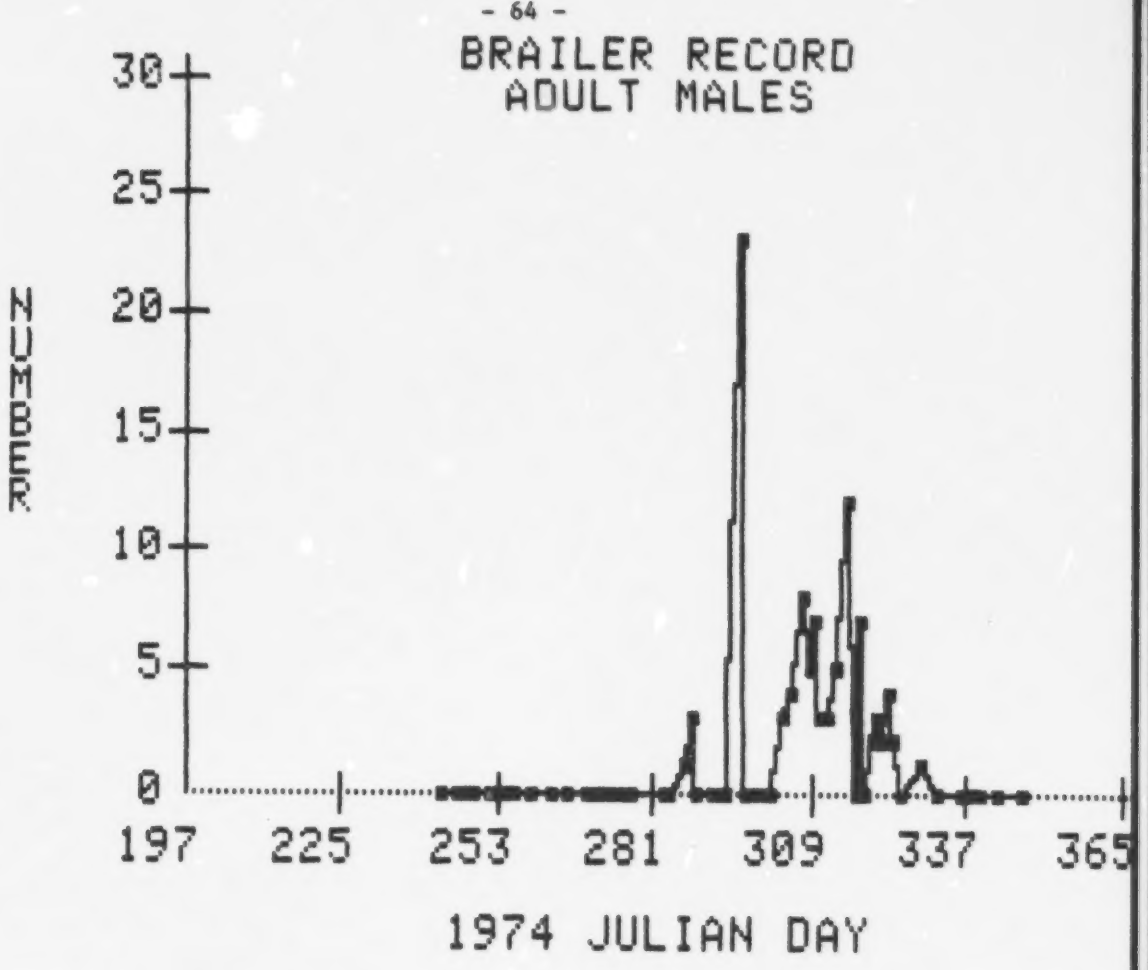

Fig. B2-74-L. Male returns per day to brailer; 1974.

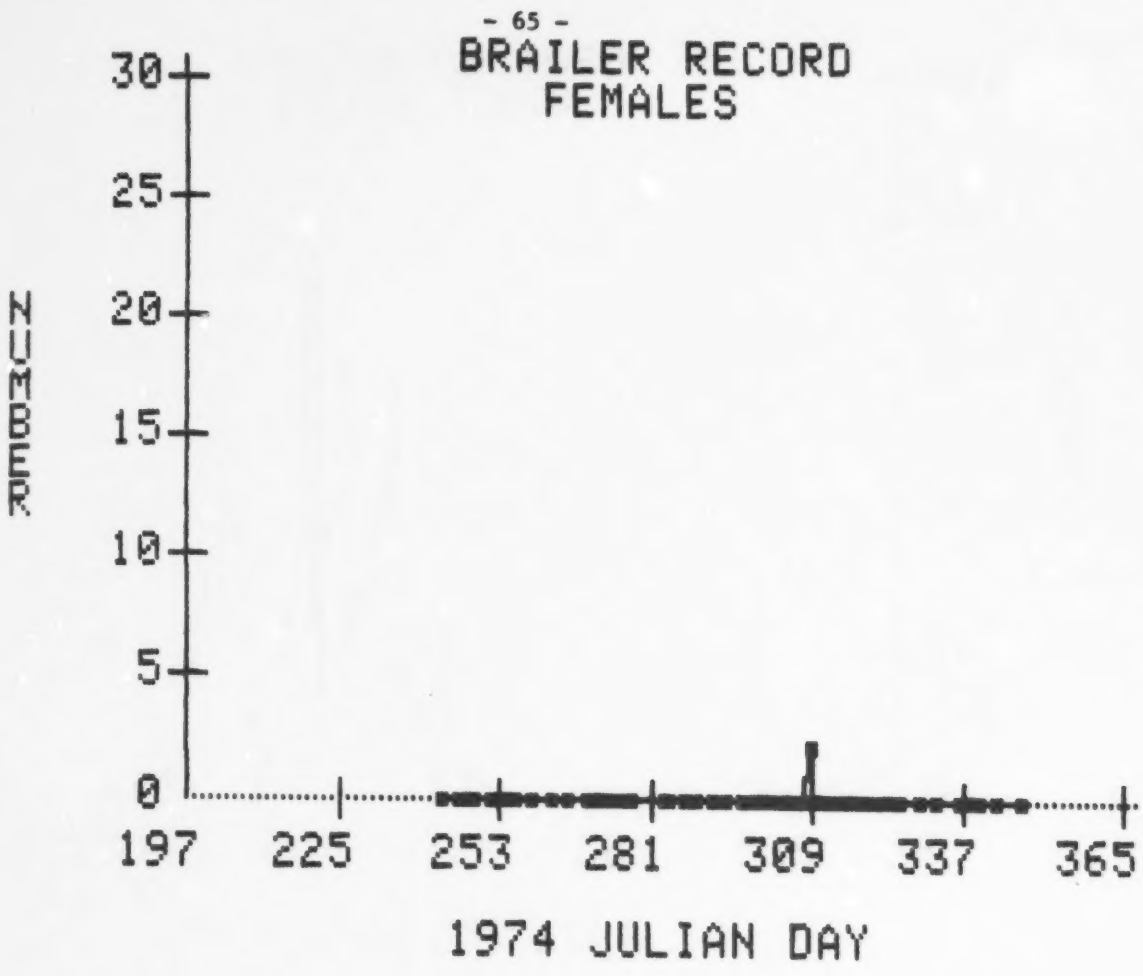

Fig. B2-74-R. Female returns per day to brailer; 1974.

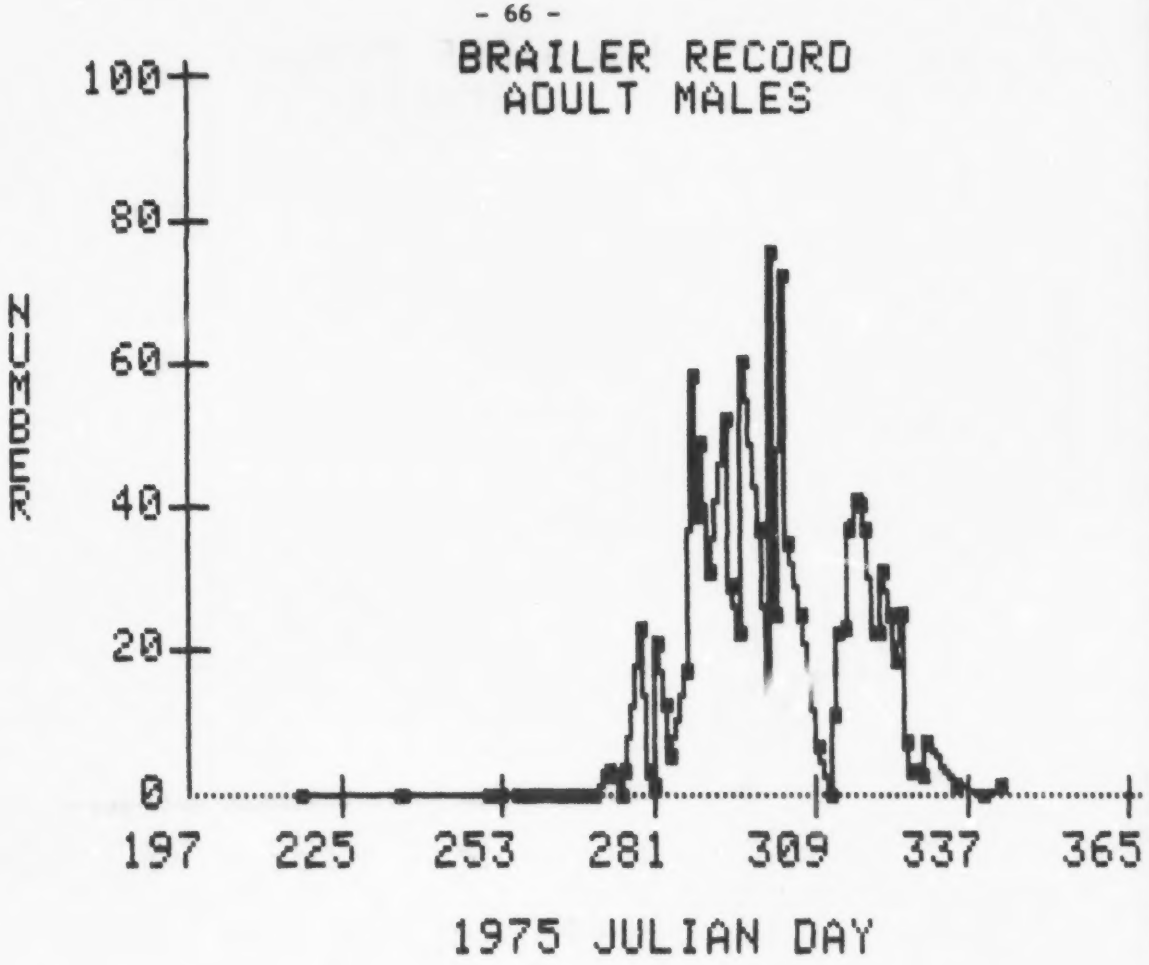

Fig. B2-75-L. Male returns per day to brailer; 1975.

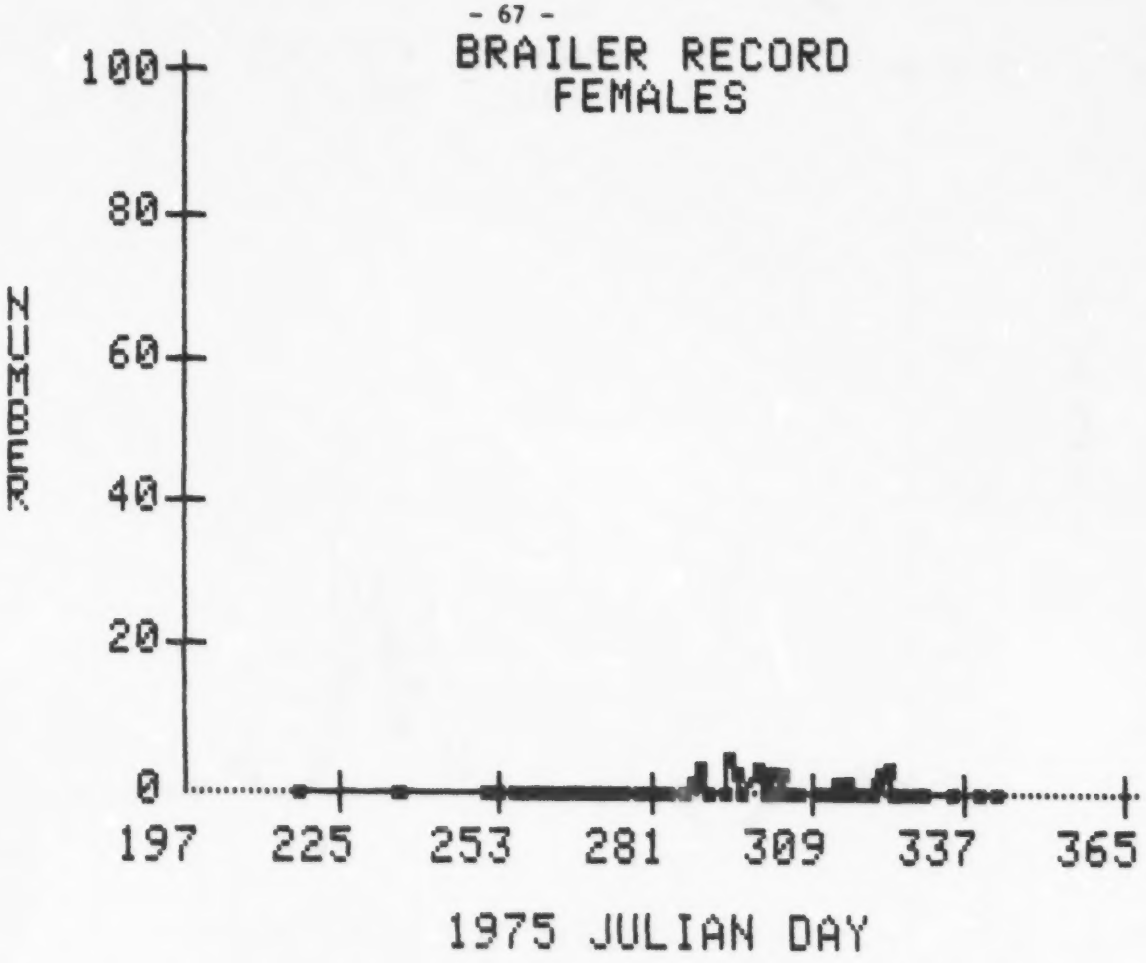

Fig. B2-75-R. Female returns per day to brailer; 1975.

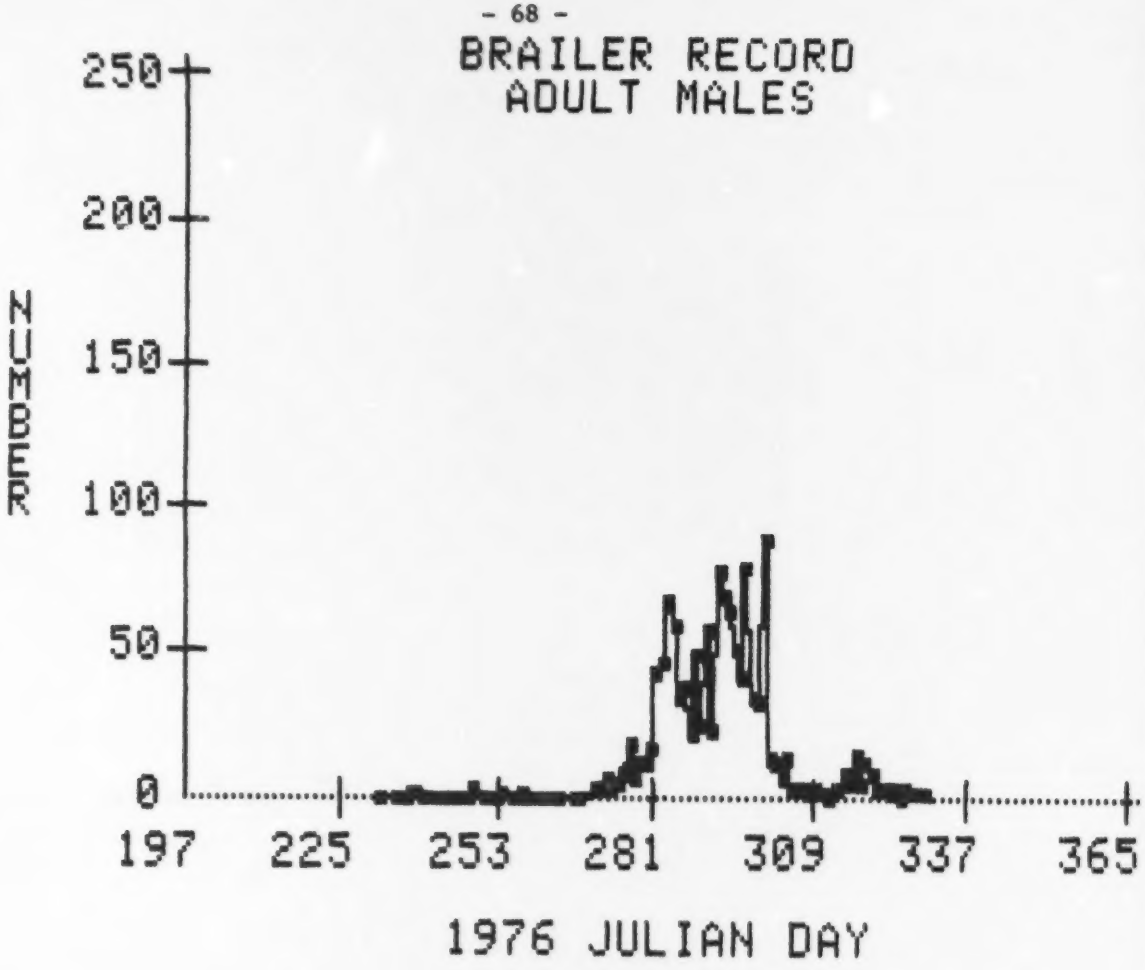

Fig. B2-76-L. Male returns per day to brailer; 1976.

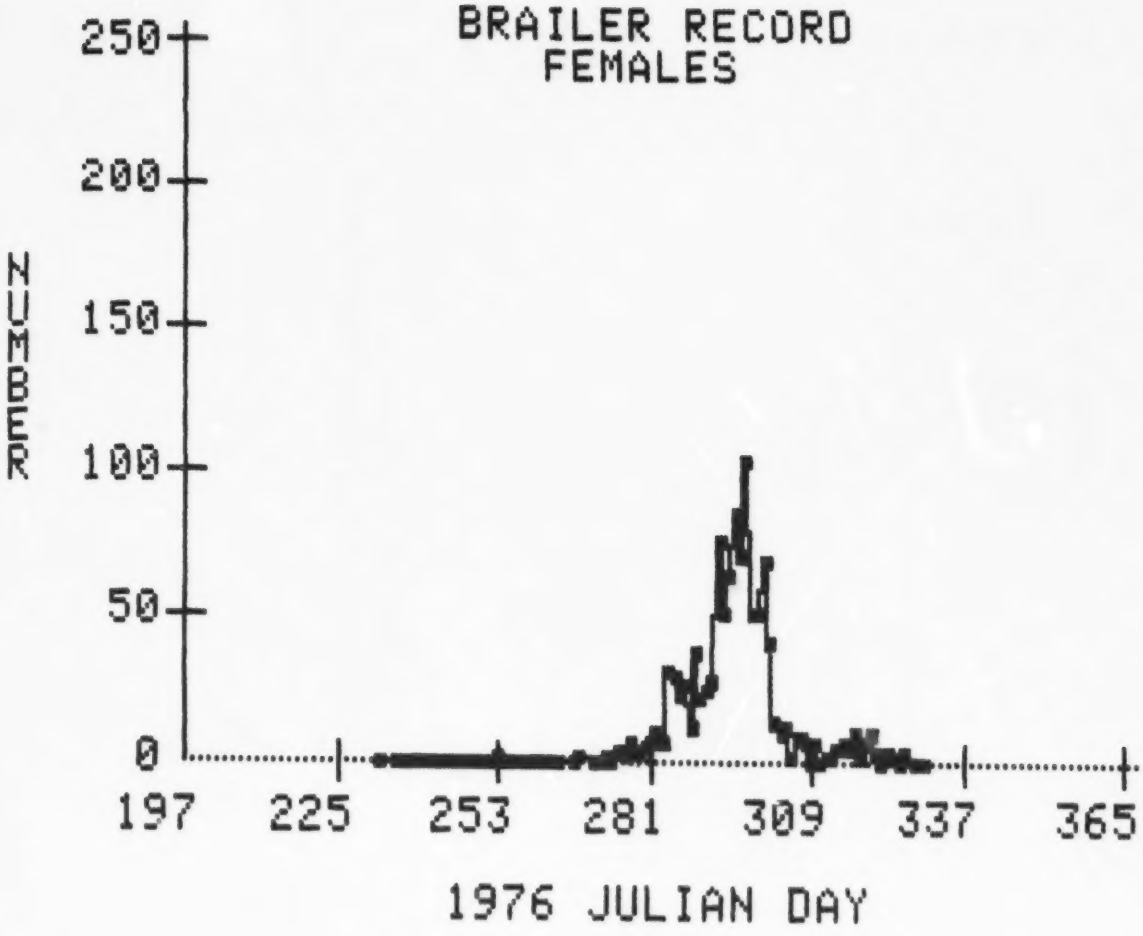

Fig. B2-76-R. Female returns per day to brailer; 1976.

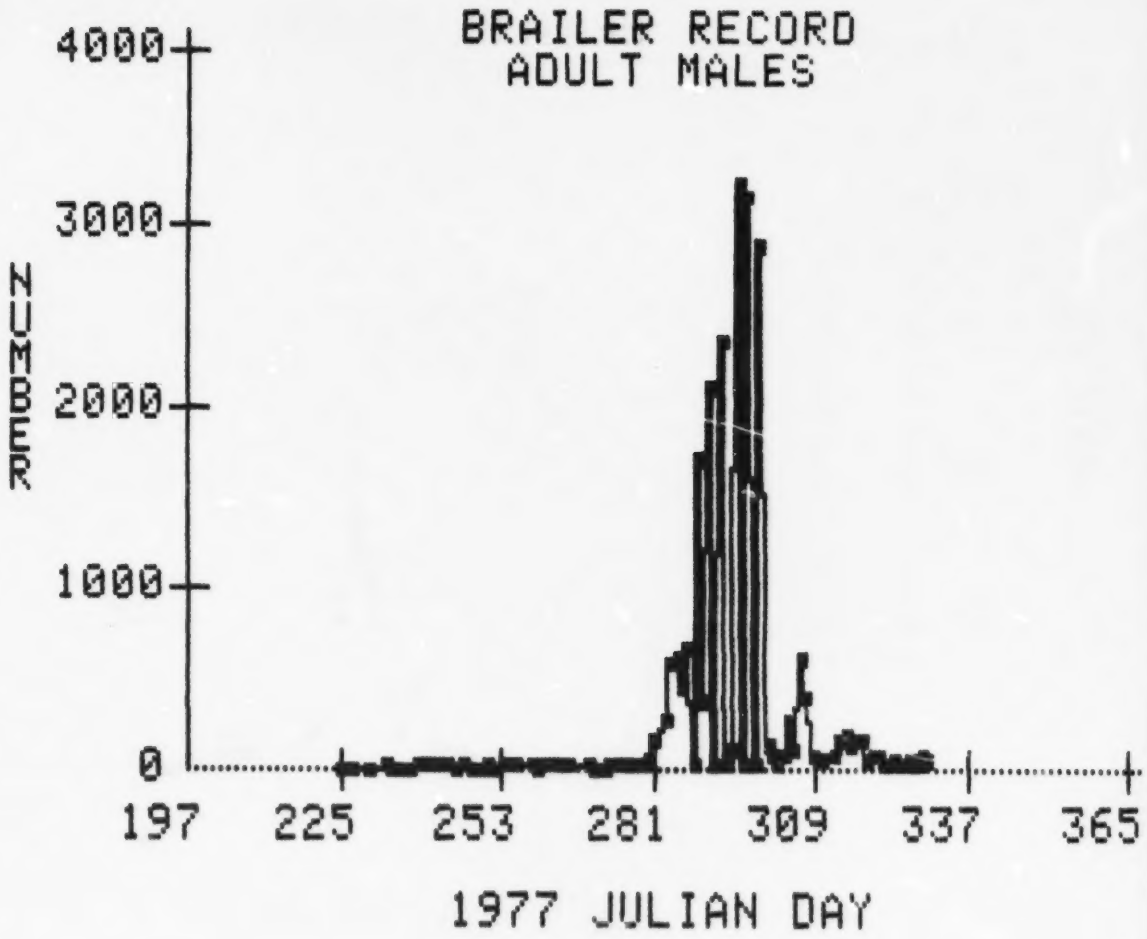

Fig. B2-77-L. Male returns per day to brailer; 1977.

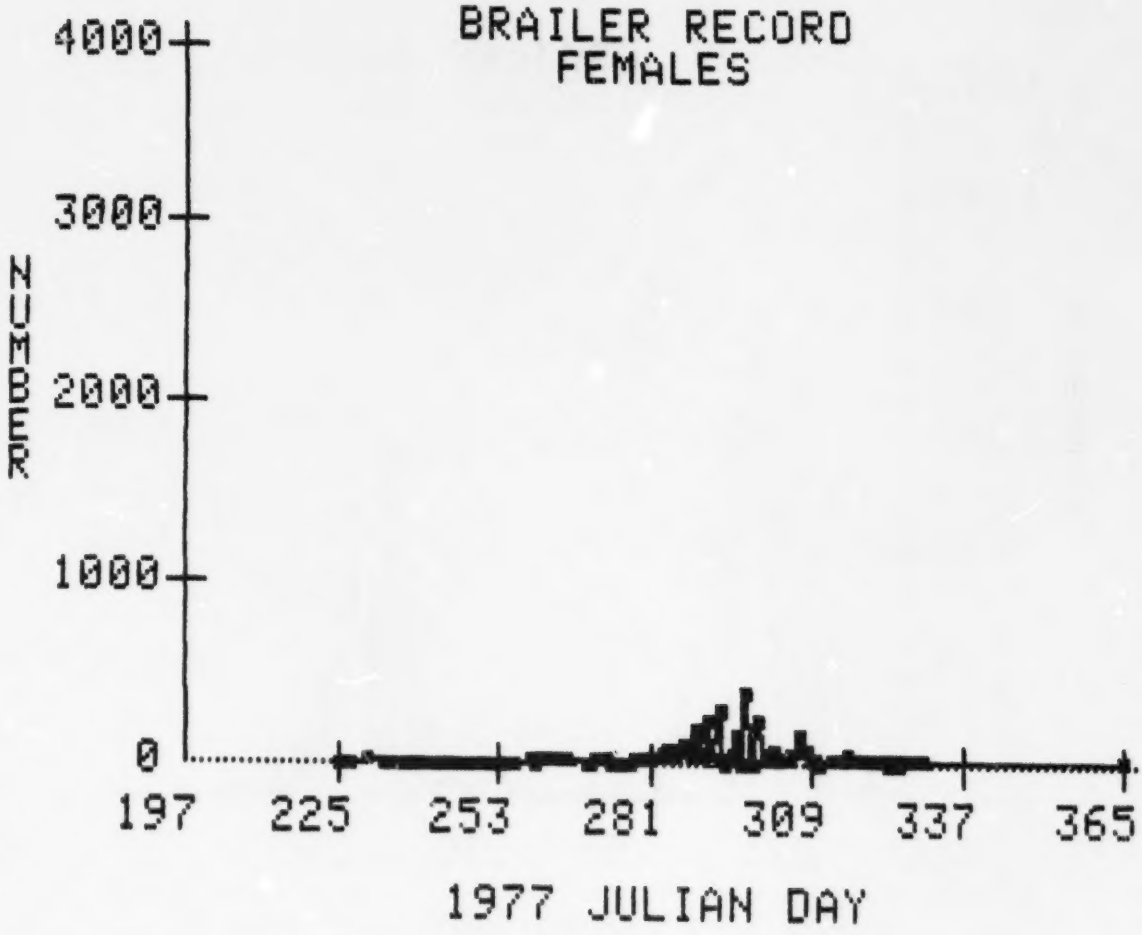

Fig. B2-77-R. Female returns per day to brailer; 1977.

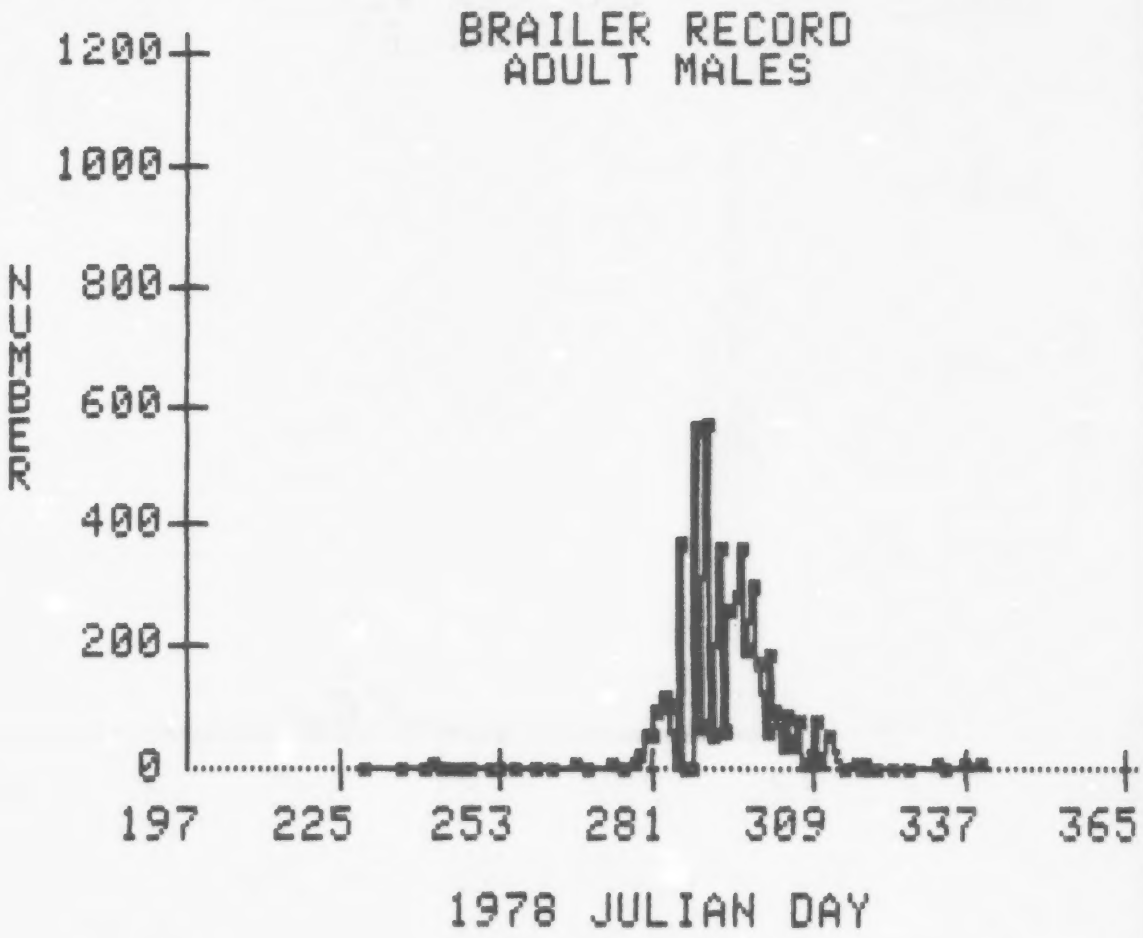

Fig. B2-78-L. Male returns per day to brailer; 1978.

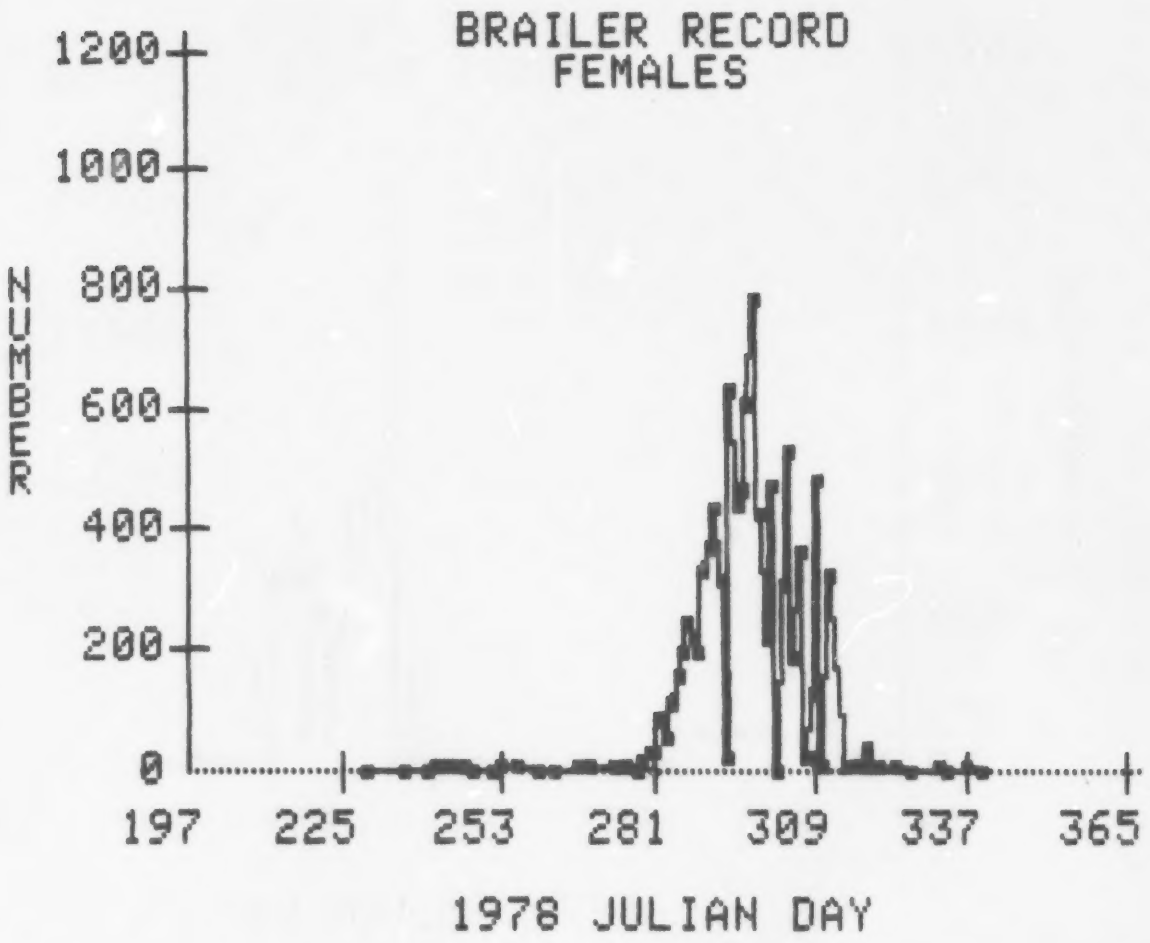

Fig. B2-78-R. Female returns per day to brailer; 1978.

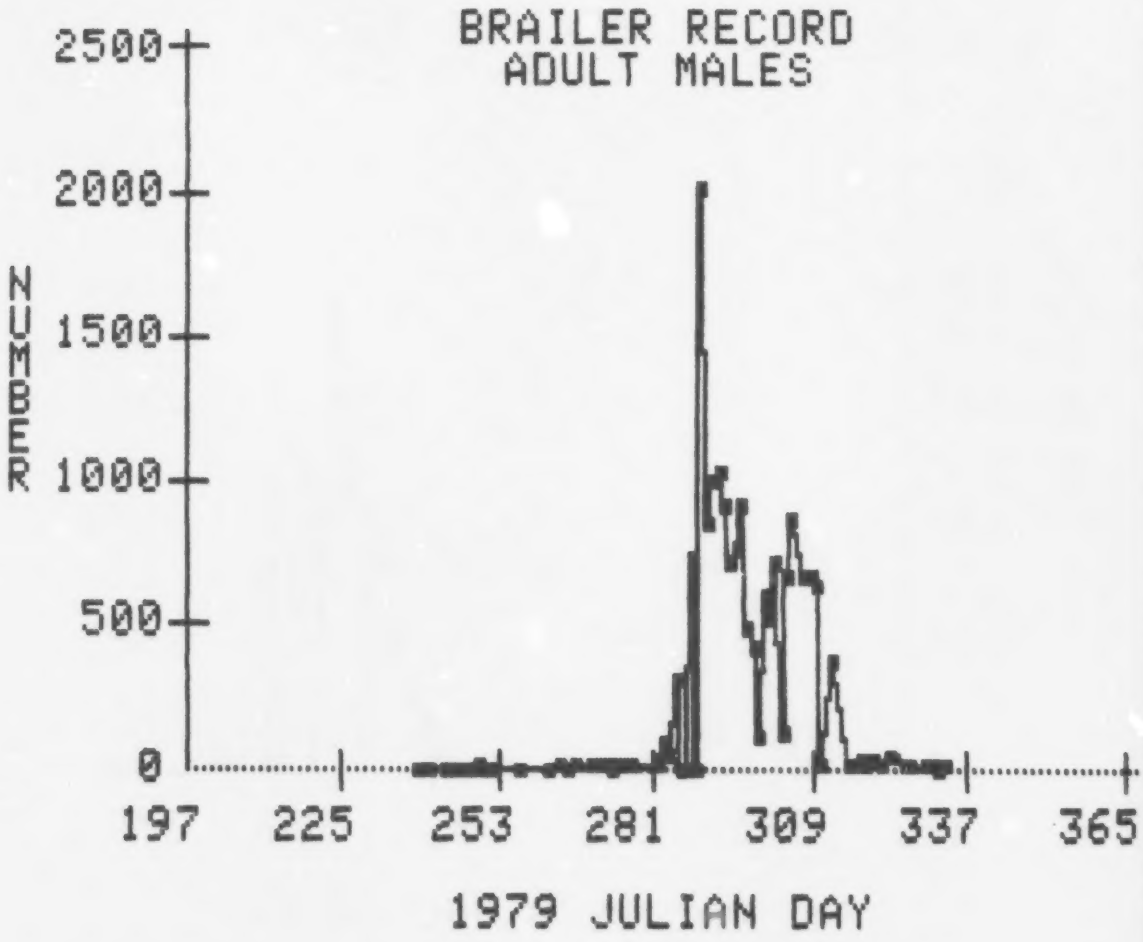

Fig. B2-79-L. Male returns per day to brailer; 1979.

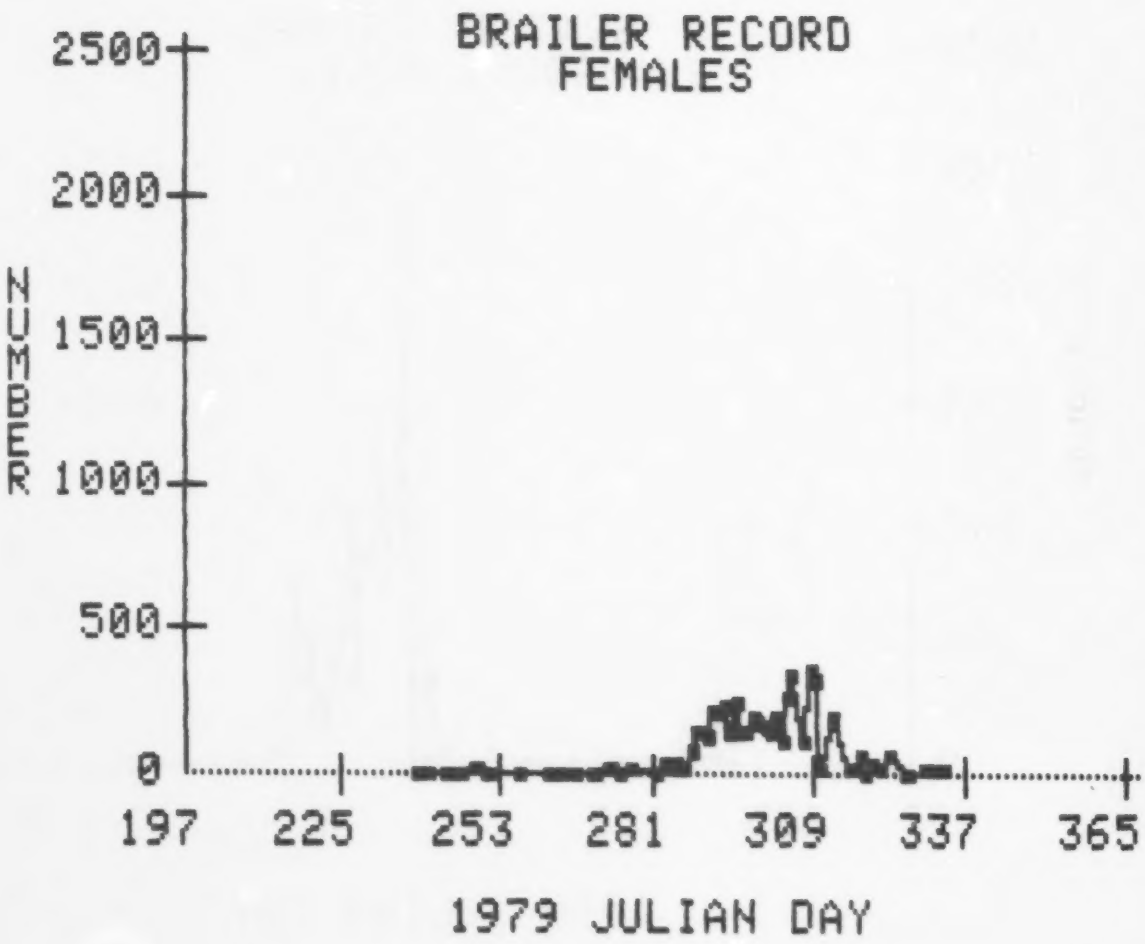

Fig. B2-79-R. Female returns per day to brailer; 1979.

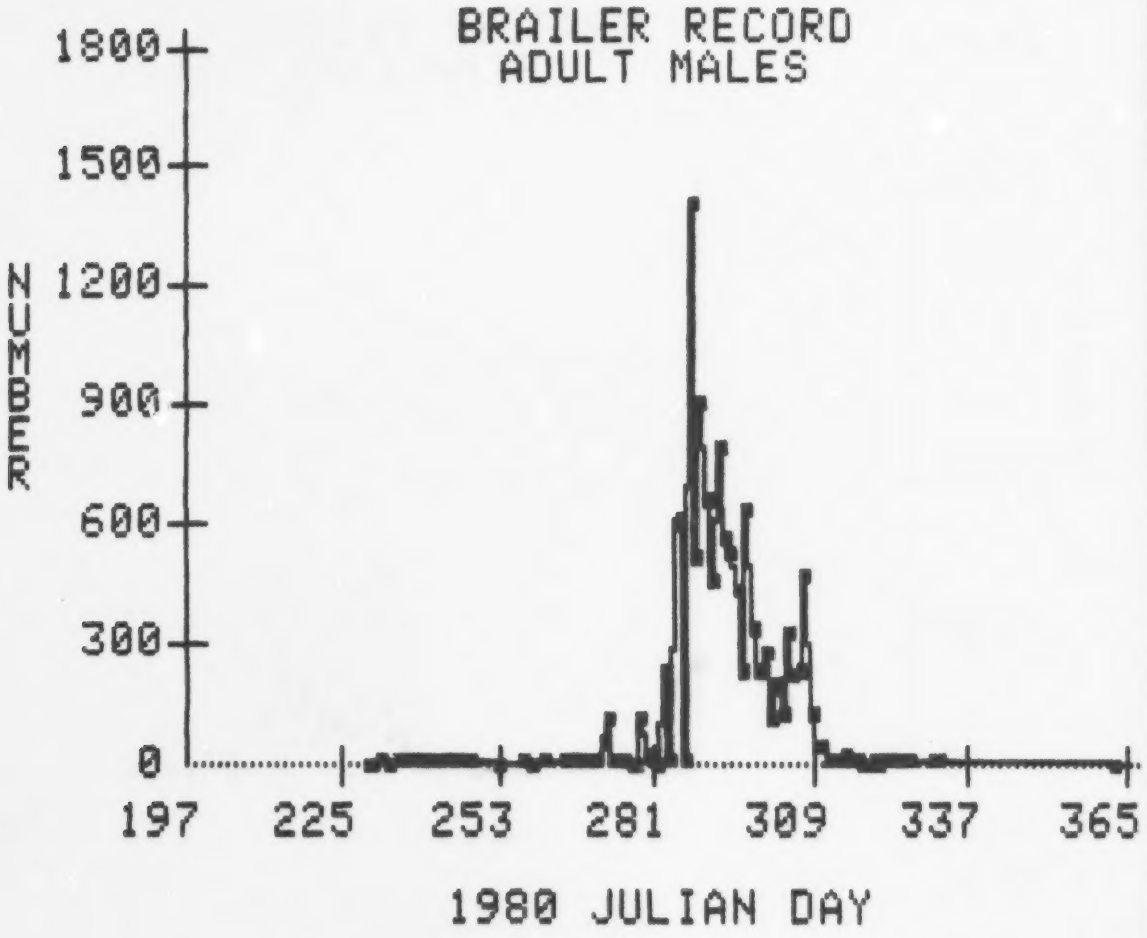

Fig. B2-80-L. Male returns per day to brailer; 1980.

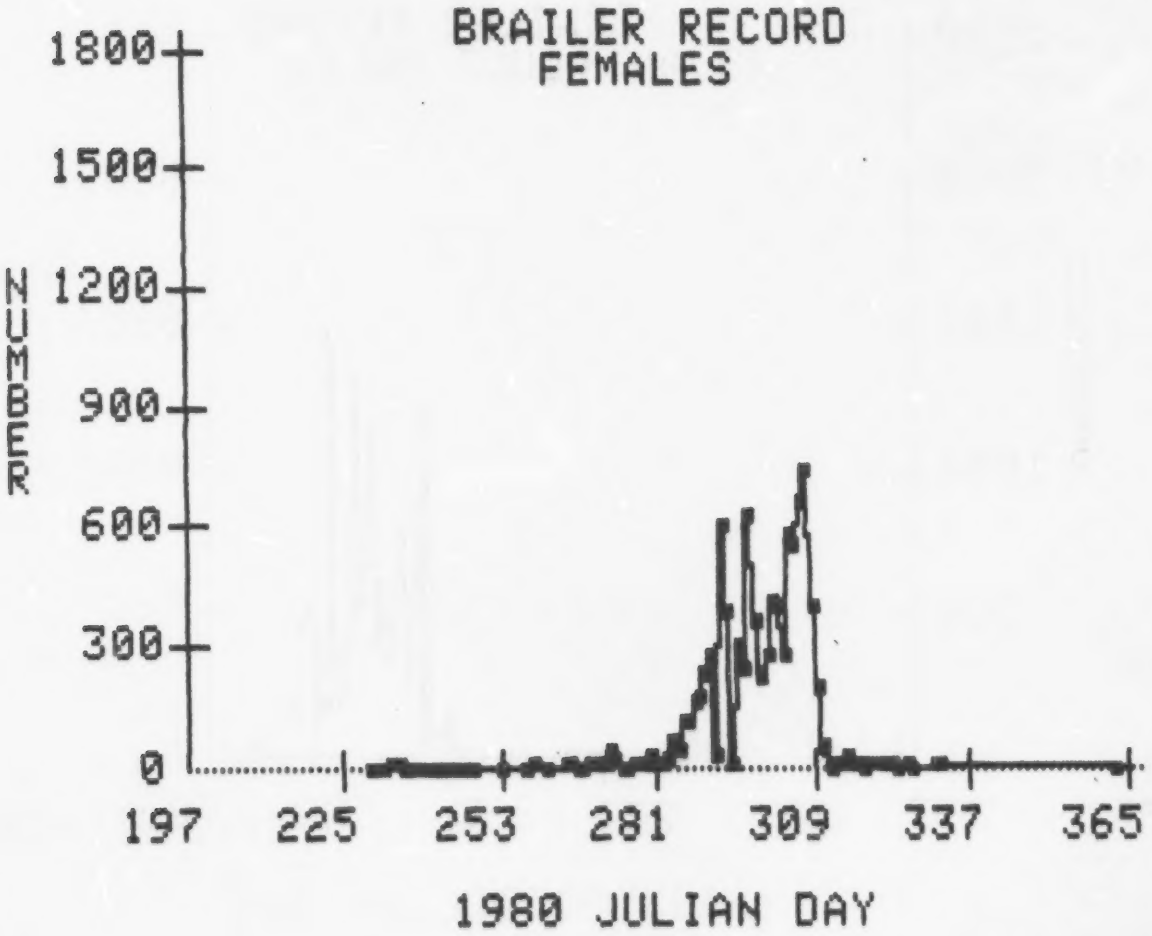

Fig. B2-80-R. Female returns per day to brailer; 1980.

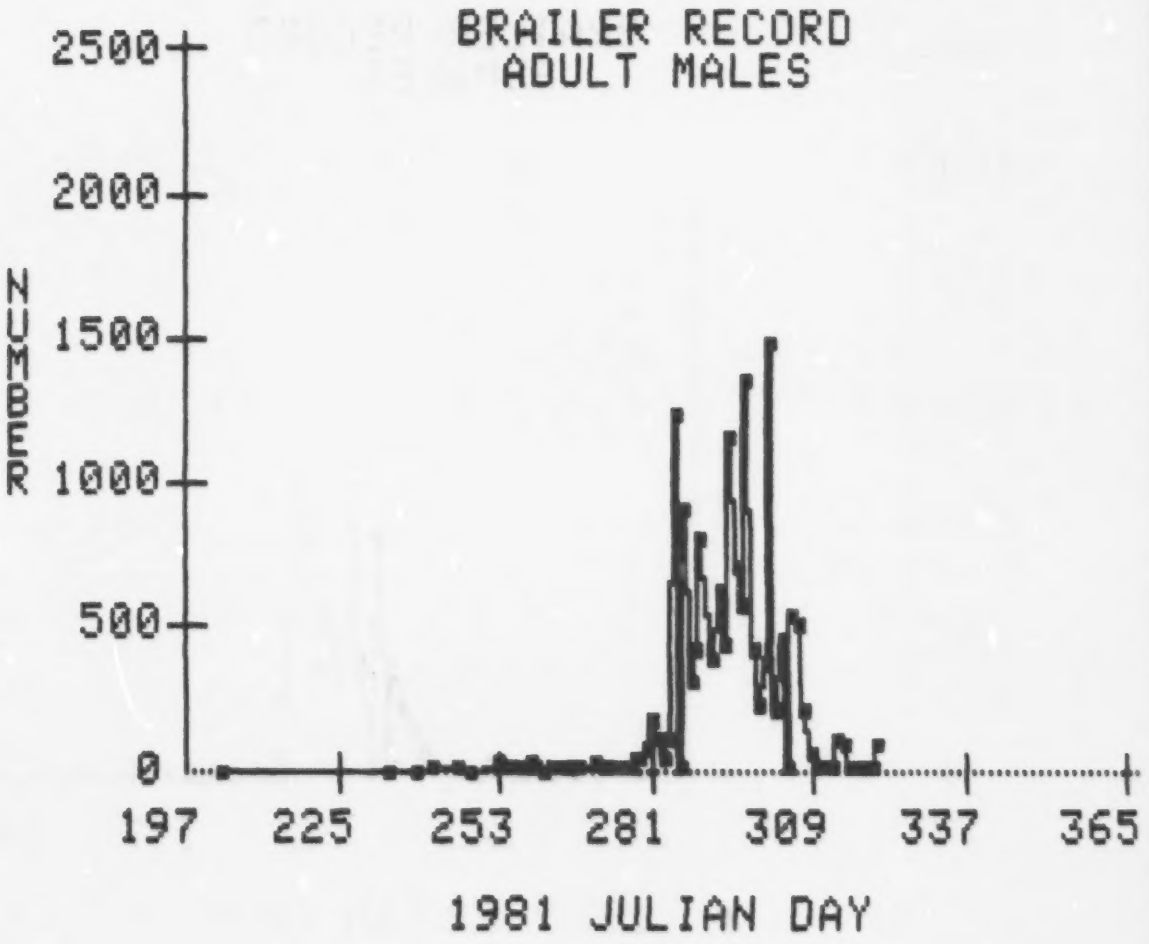

Fig. B2-81-L. Male returns per day to brailer; 1981.

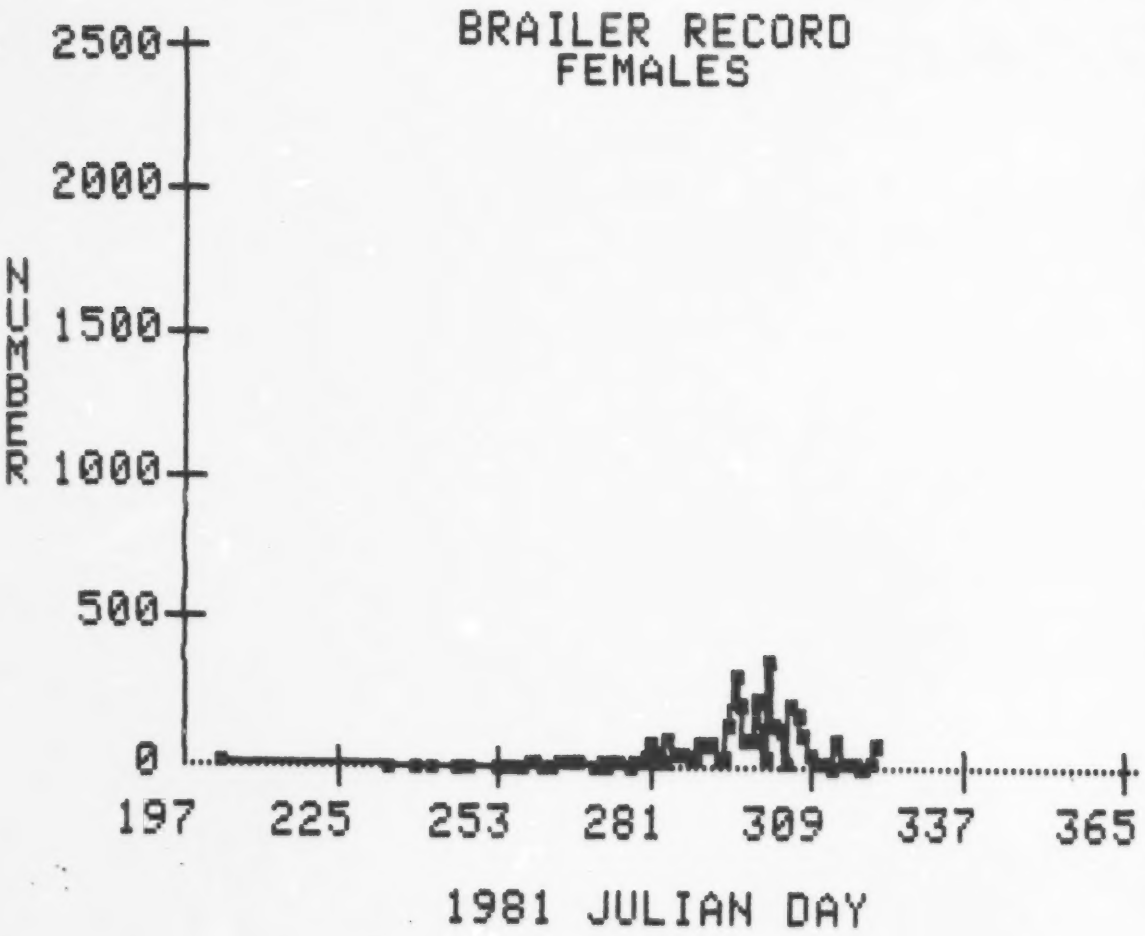

Fig. B2-81-R. Female returns per day to brailer; 1981.

FIG. B3

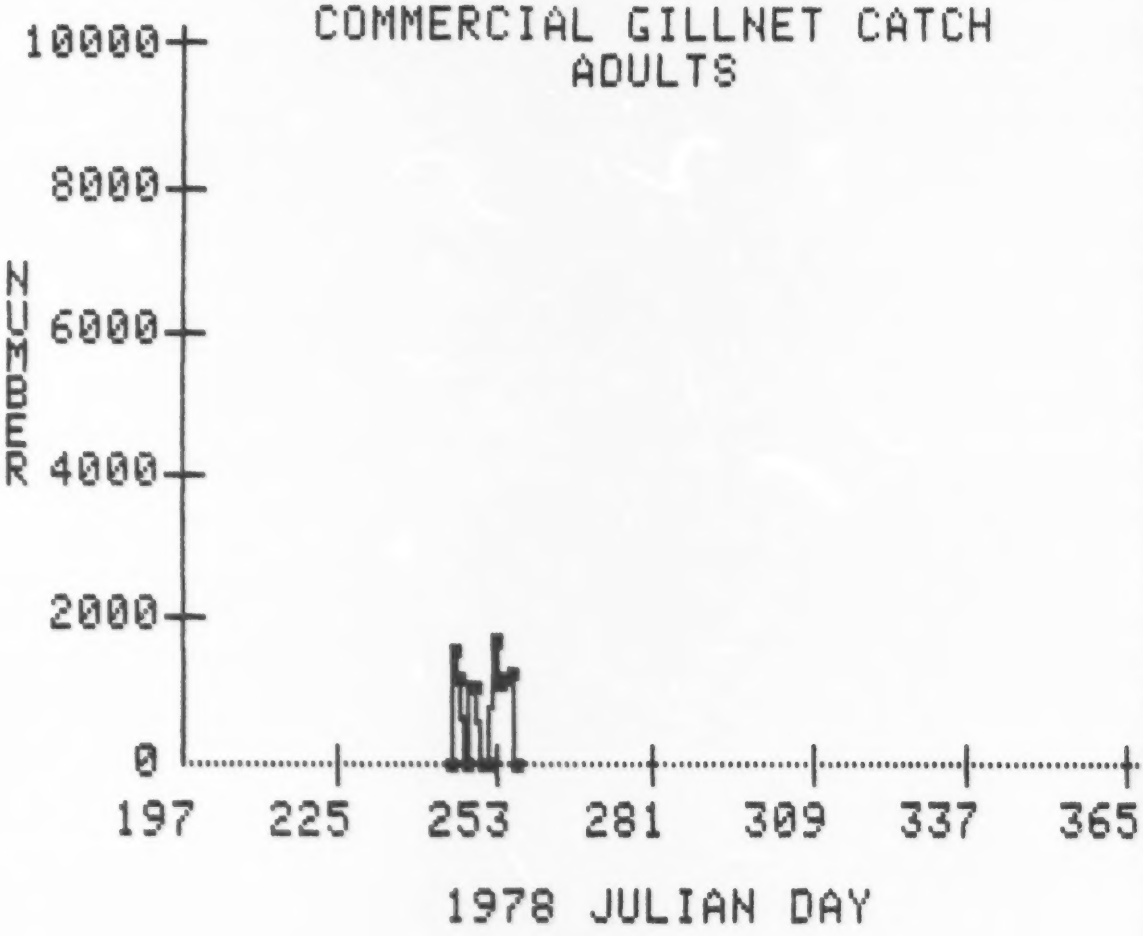

Fig. B3-78-L. Commercial gillnet adult catch per day; 1978.

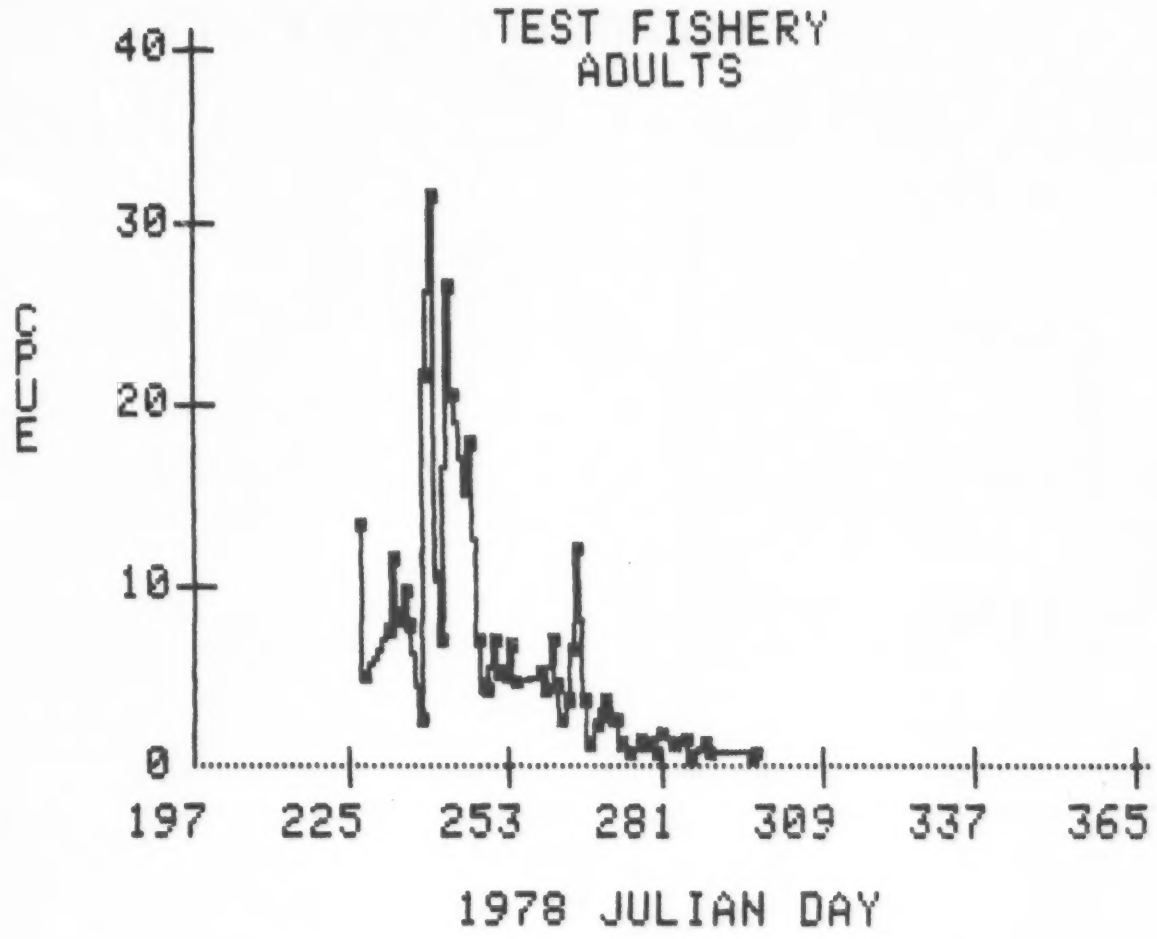

Fig. B3-78-R. Test fishery adult catch per hour; 1978.

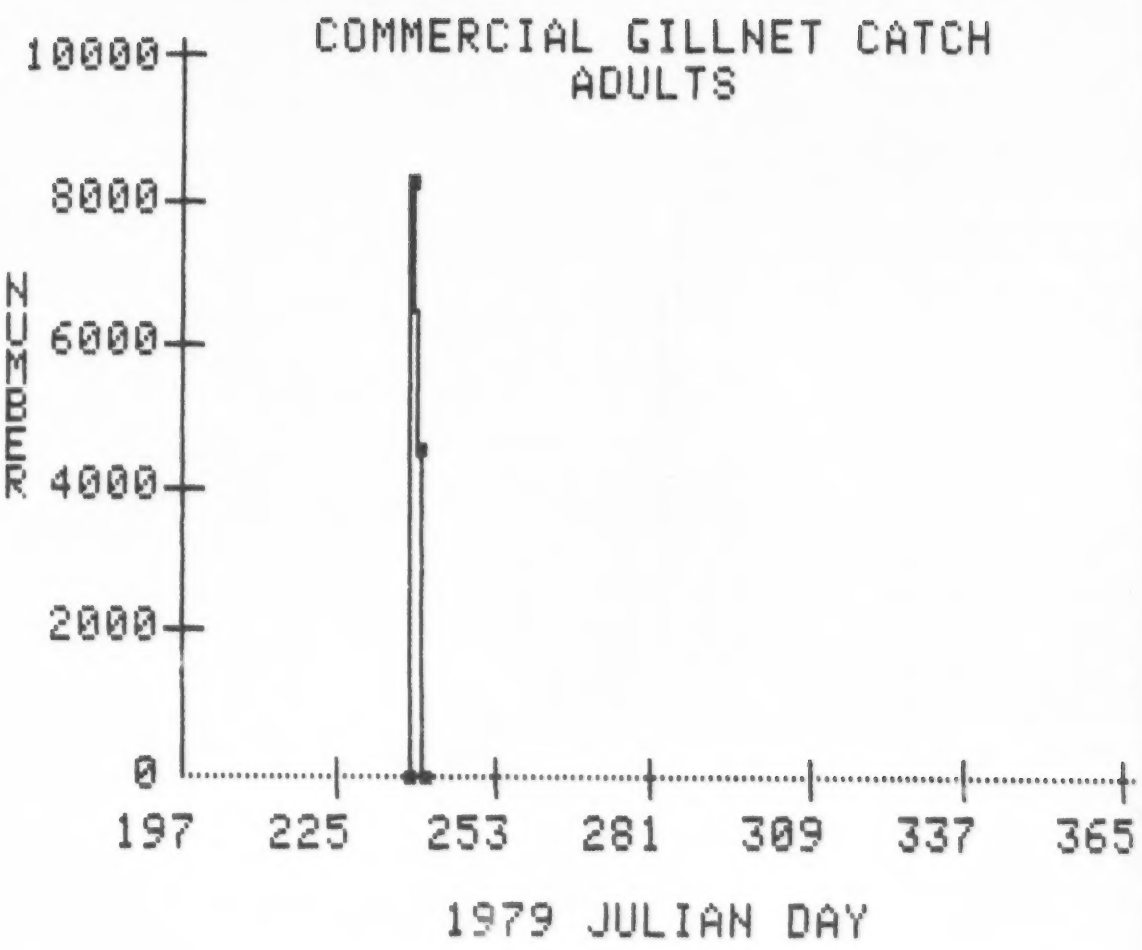

Fig. B3-79-L. Commercial gillnet adult catch per day; 1979.

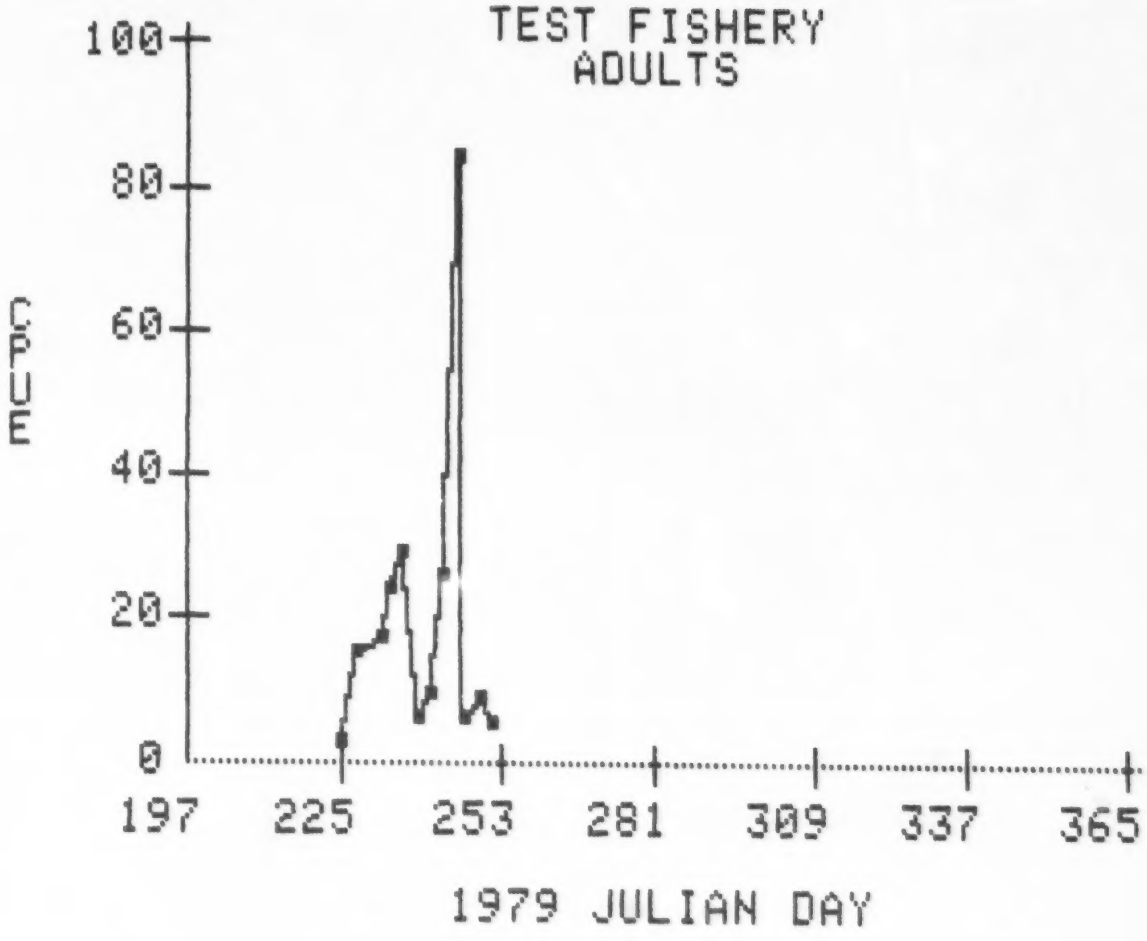

Fig. B3-79-R. Test fishery adult catch per hour; 1979.

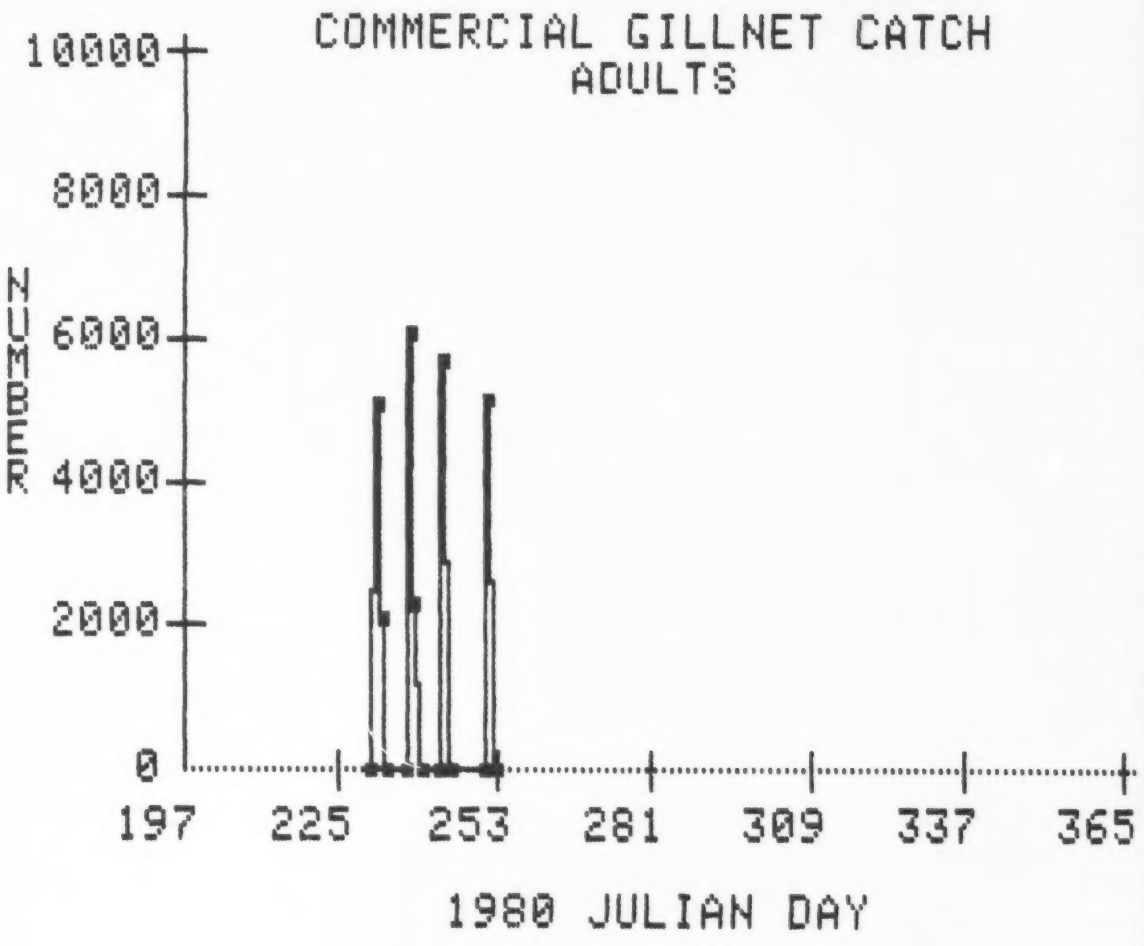

Fig. B3-80-L. Commercial gillnet adult catch per day; 1980.

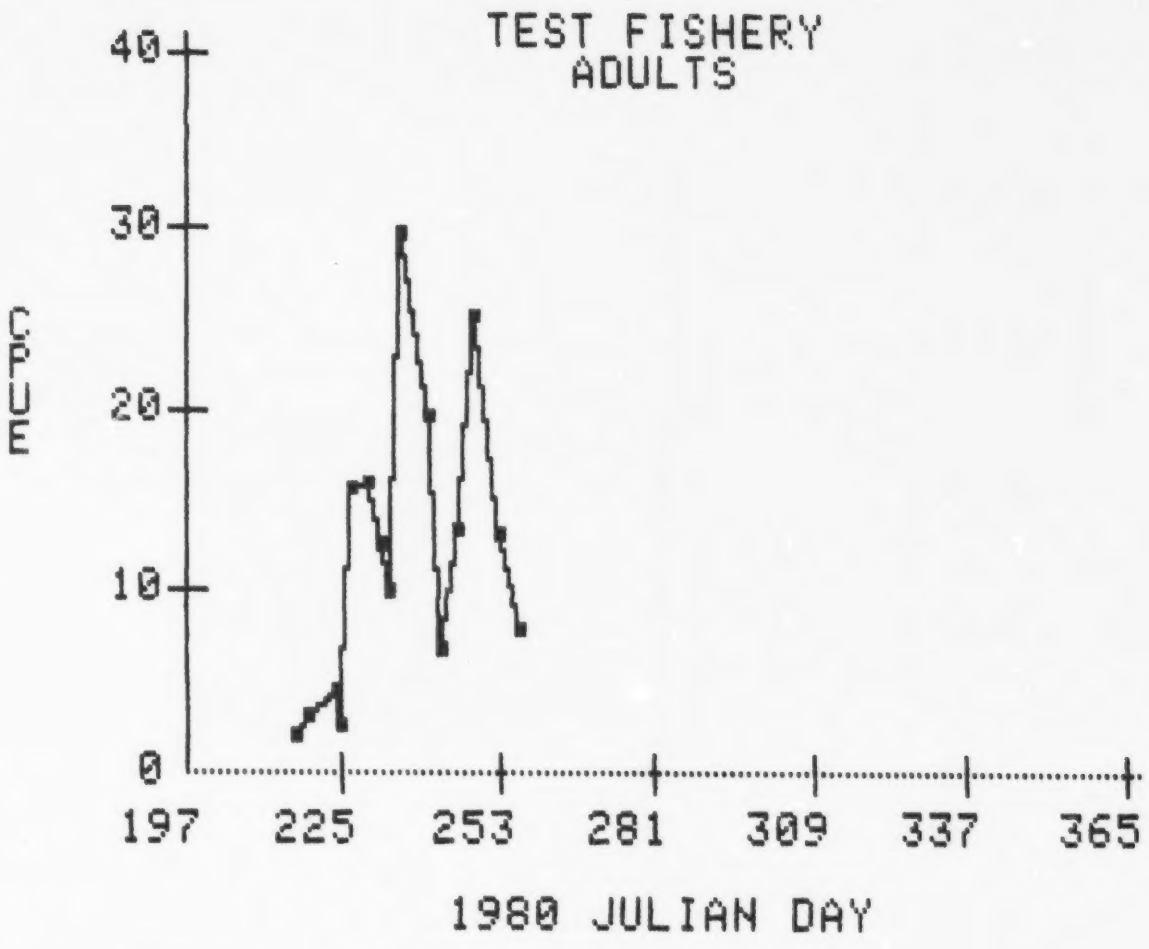

Fig. B3-80-R. Test fishery adult catch per hour; 1980.

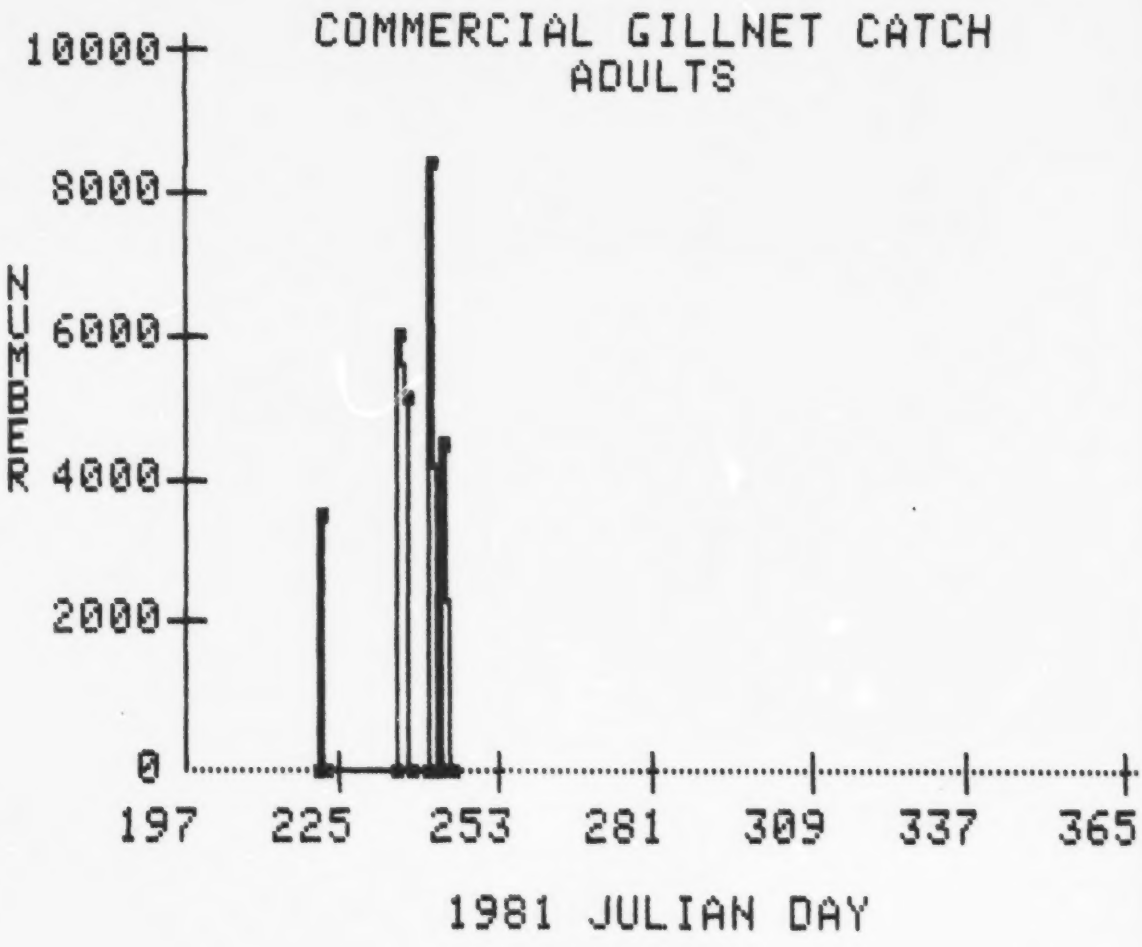

Fig. B3-81-L. Commercial gillnet adult catch per day; 1981.

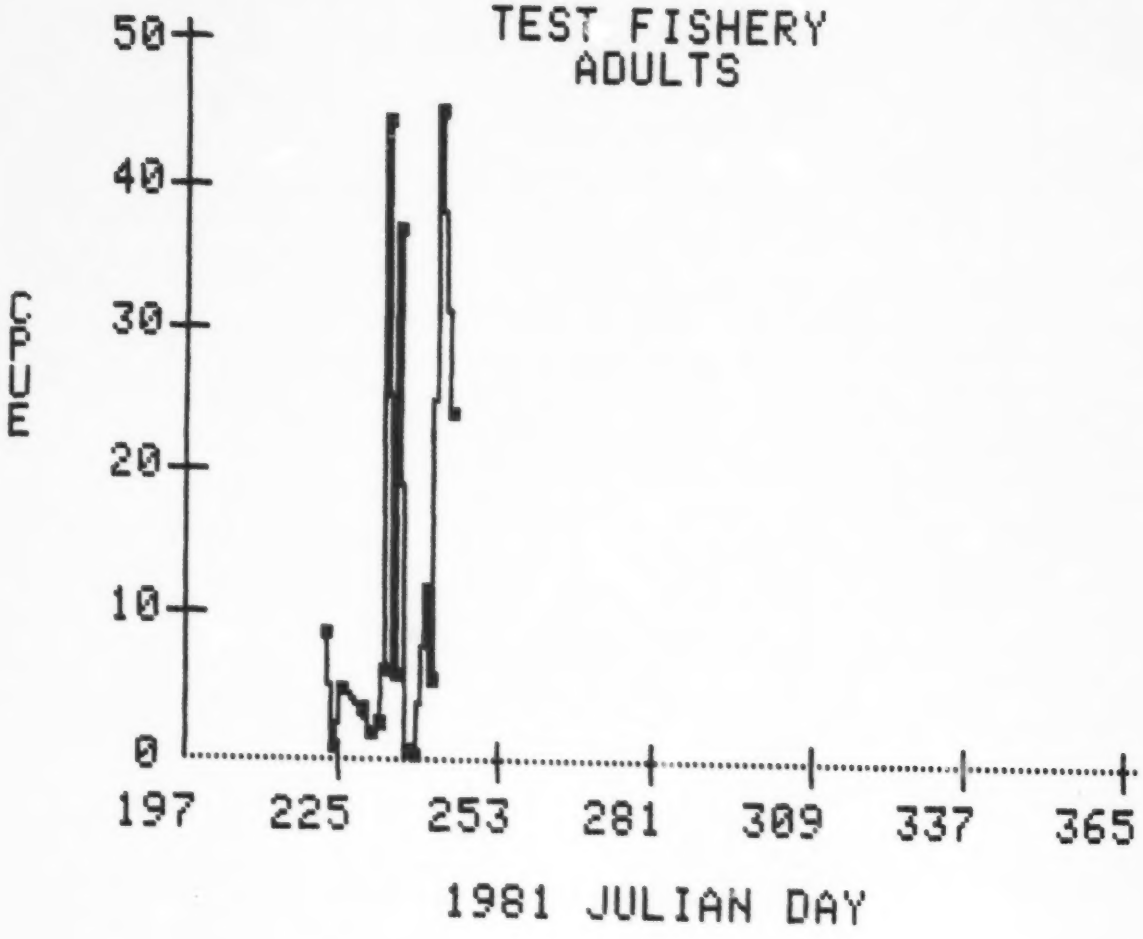

Fig. B3-81-R. Test fishery adult catch per hour; 1981.

FIG. B4

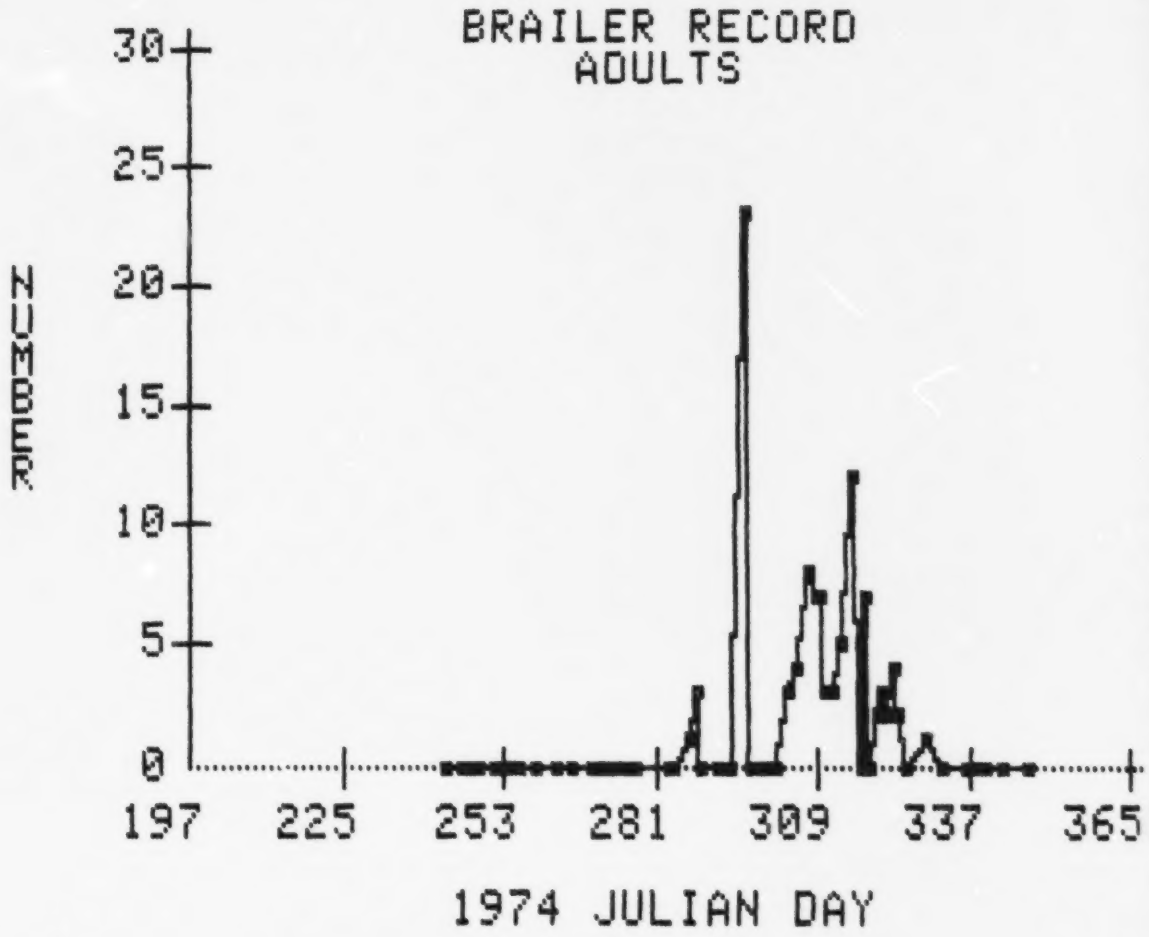

Fig. B4-74-L. Adult returns per day to brailer; 1974.

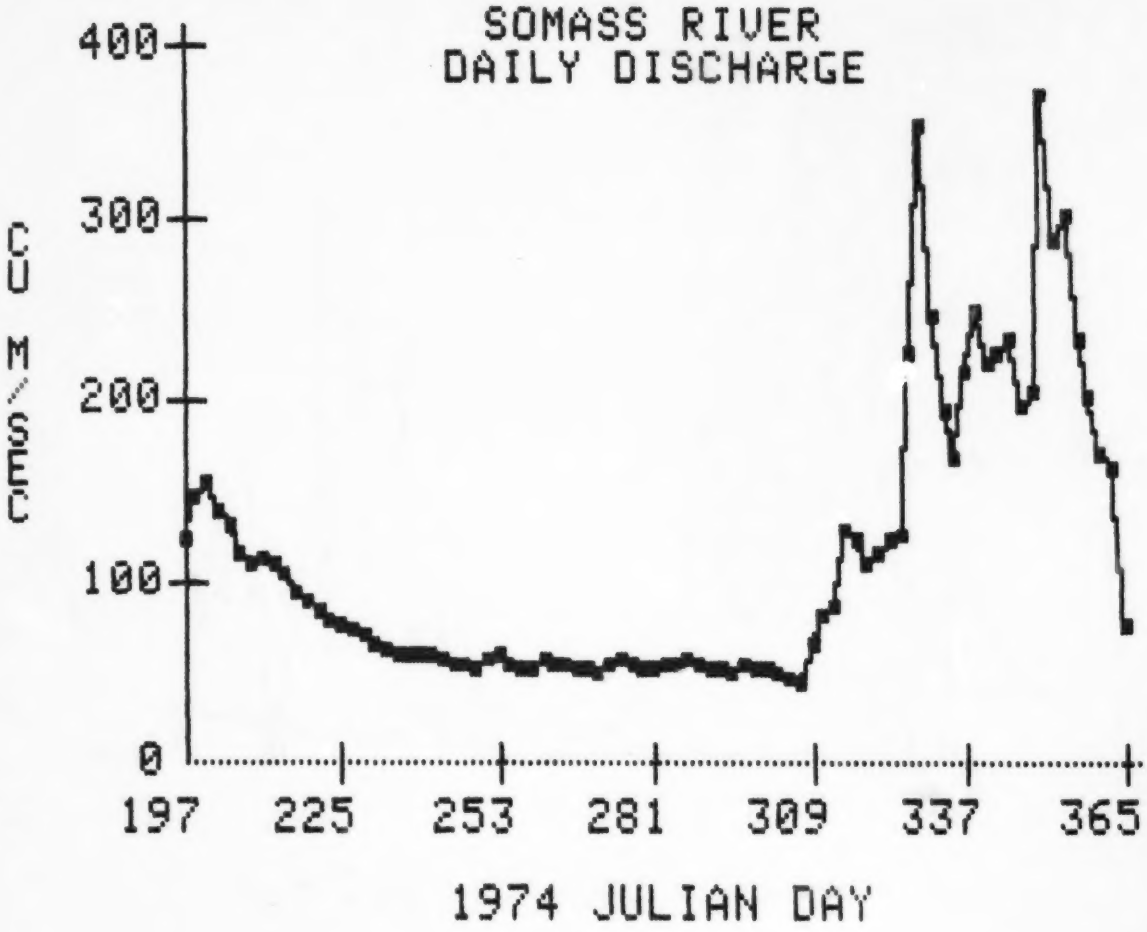

Fig. B4-74-R. Somass River daily discharge (cu m/sec); 1974.

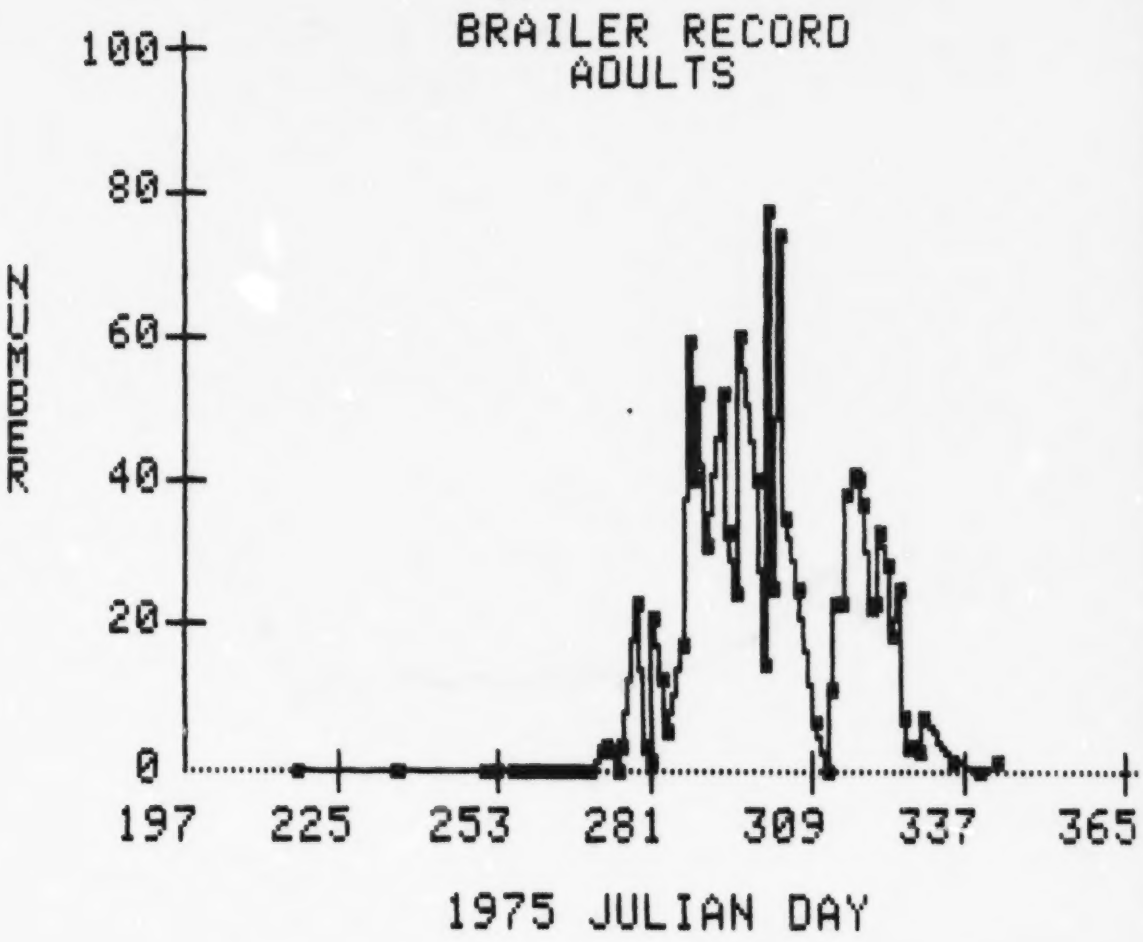

Fig. B4-75-L. Adult returns per day to brailer; 1975.

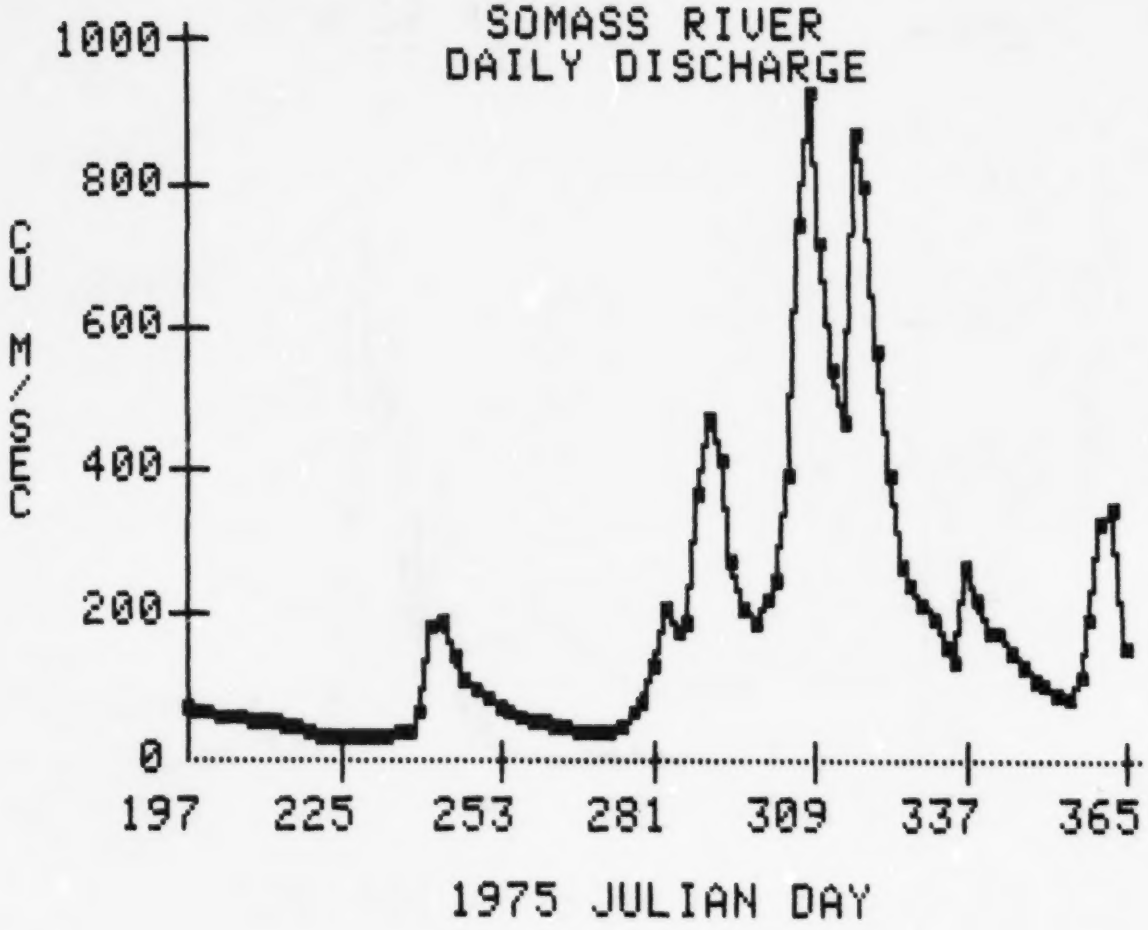

Fig. B4-75-R. Somass River daily discharge (cu m/sec); 1975.

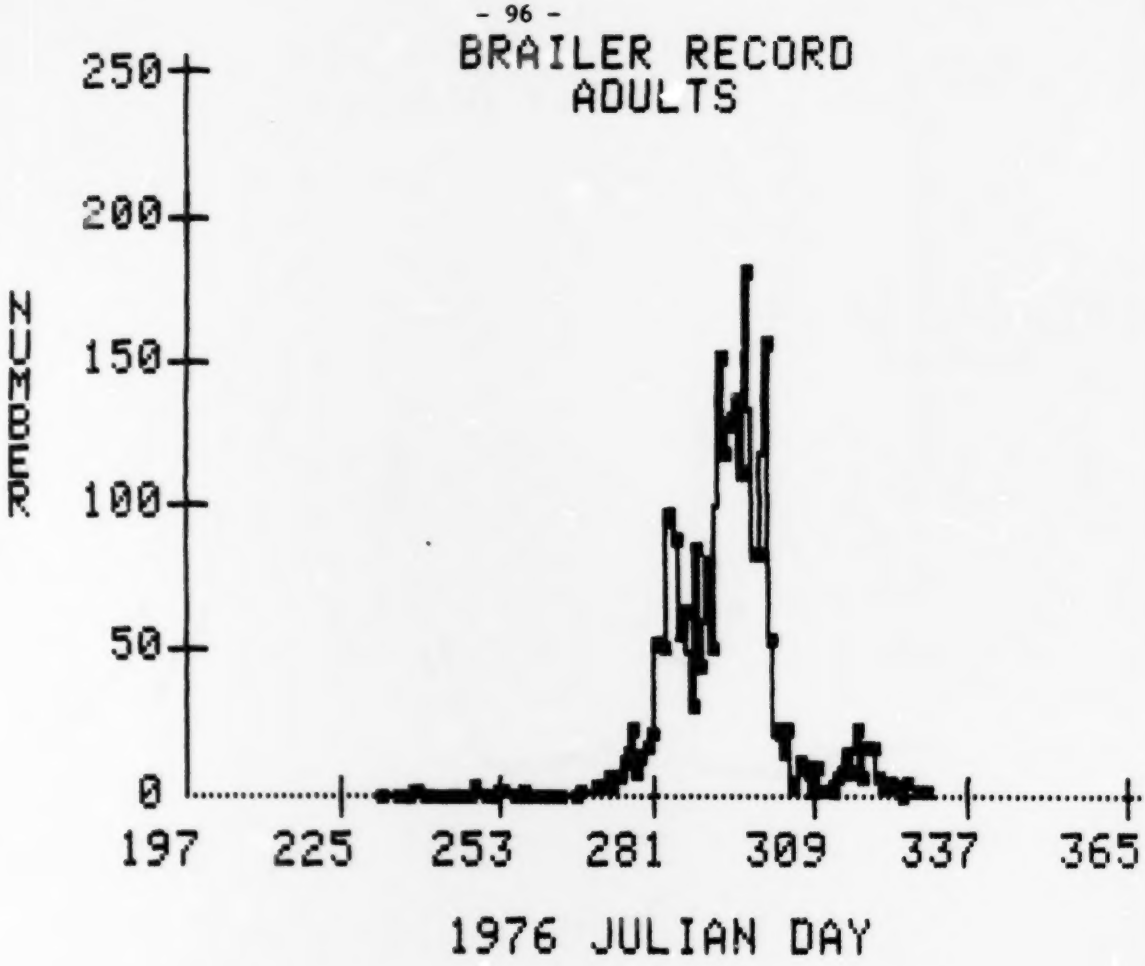

Fig. B4-76-L. Adult returns per day to brailer; 1976.

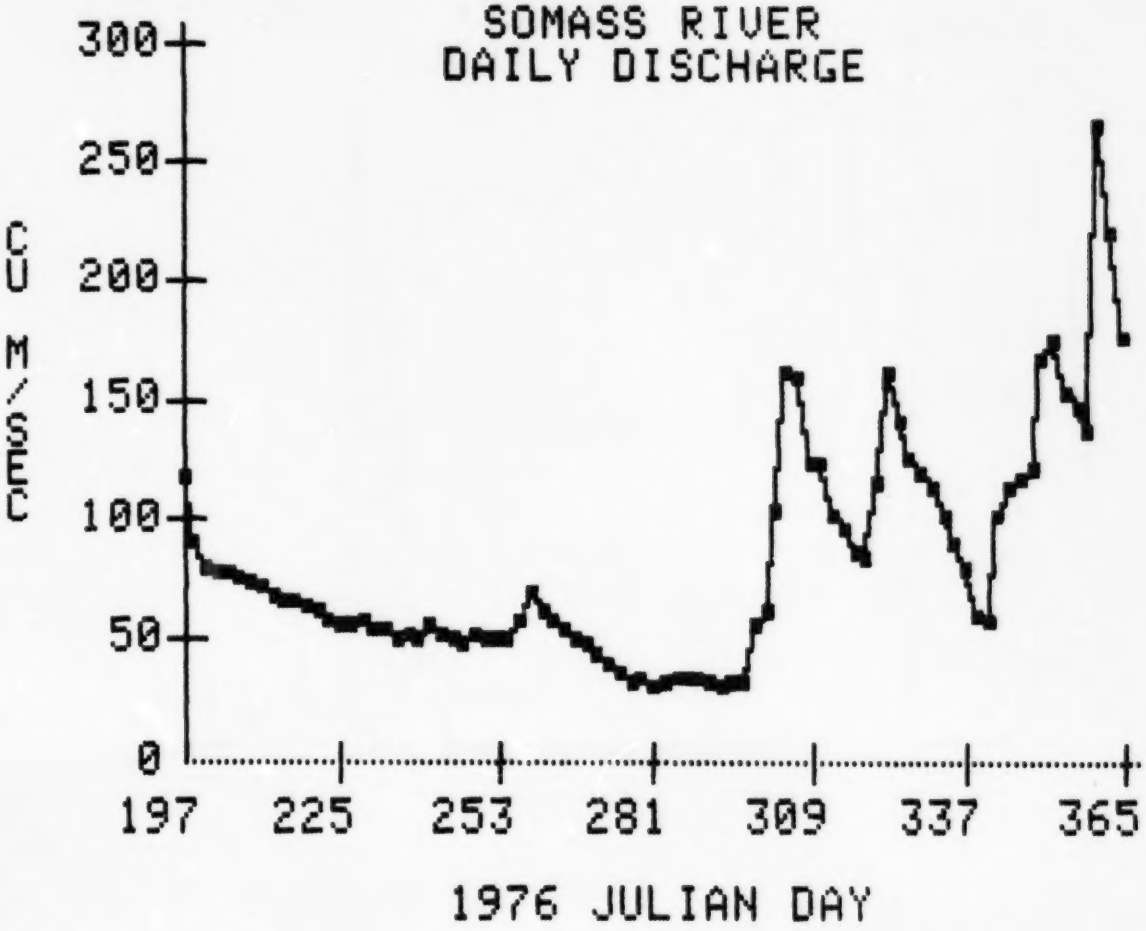

Fig. B4-76-R. Somass River daily discharge (cu m/sec); 1976.

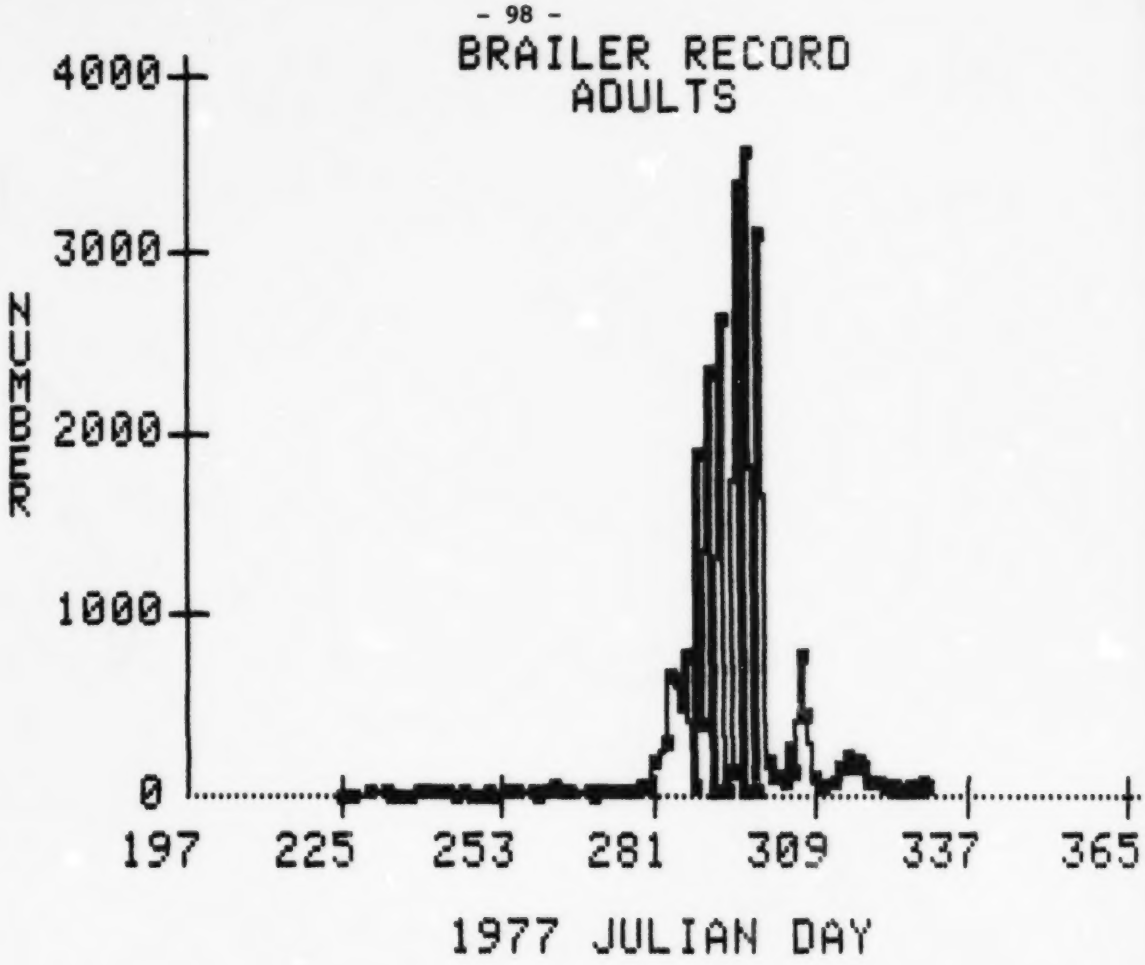

Fig. B4-77-L. Adult returns per day to brailer; 1977.

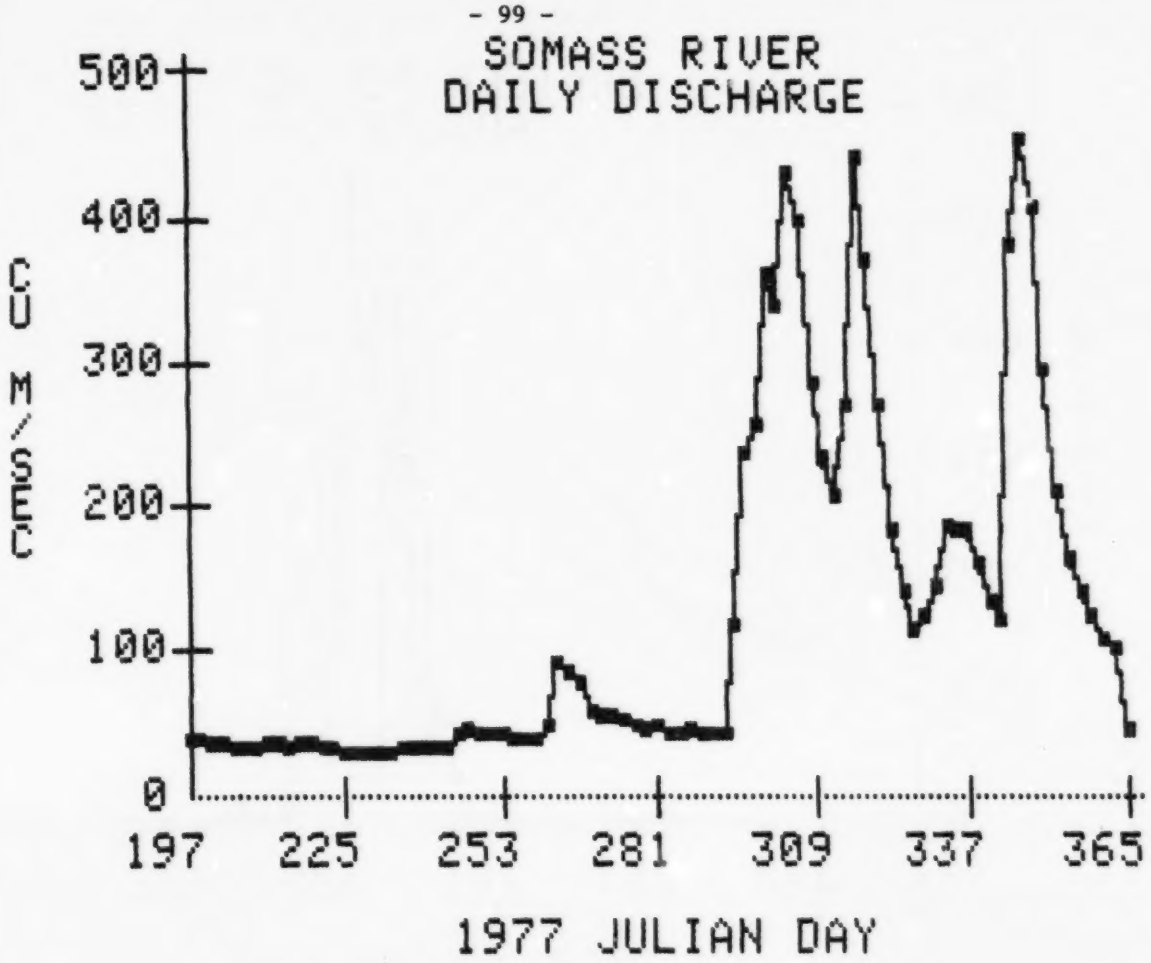

Fig. B4-77-R. Somass River daily discharge (cu m/sec); 1977.

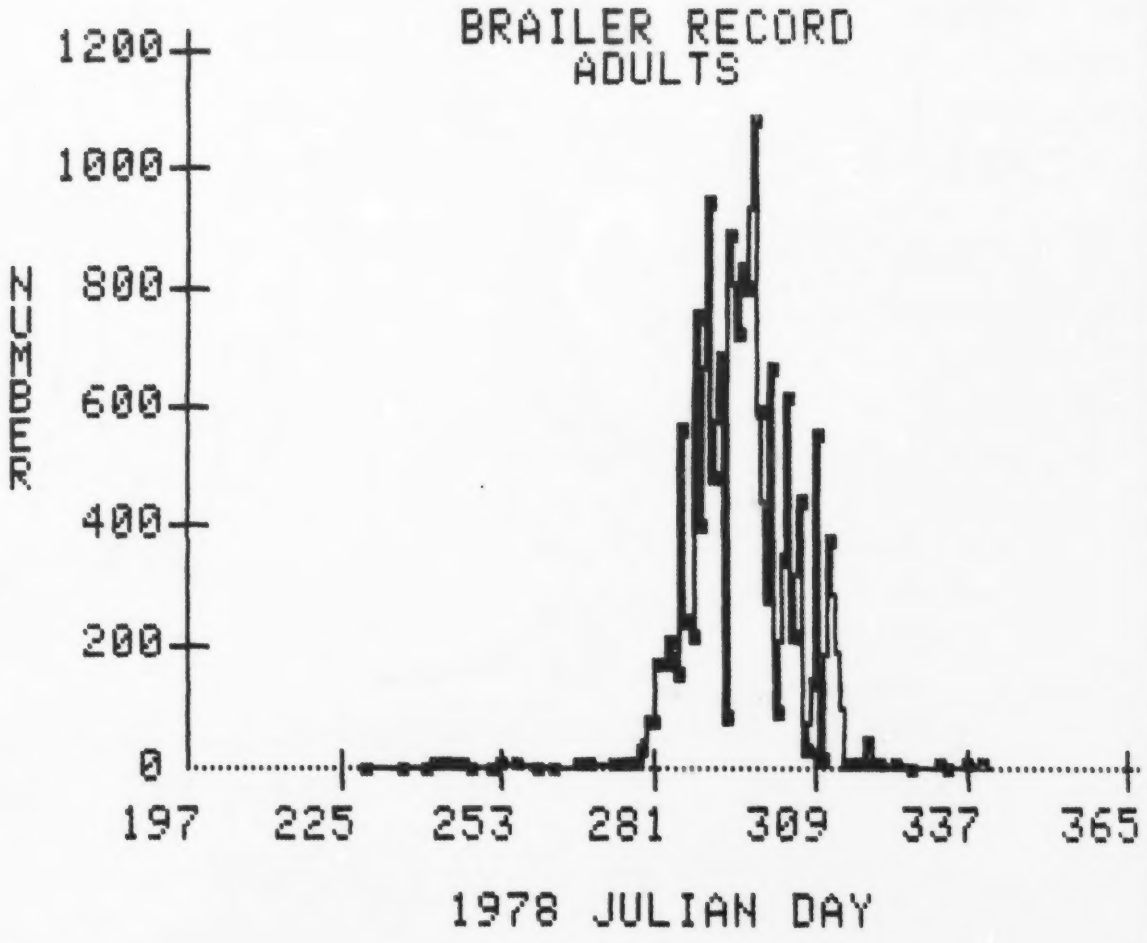

Fig. B4-78-L. Adult returns per day to brailer; 1978.

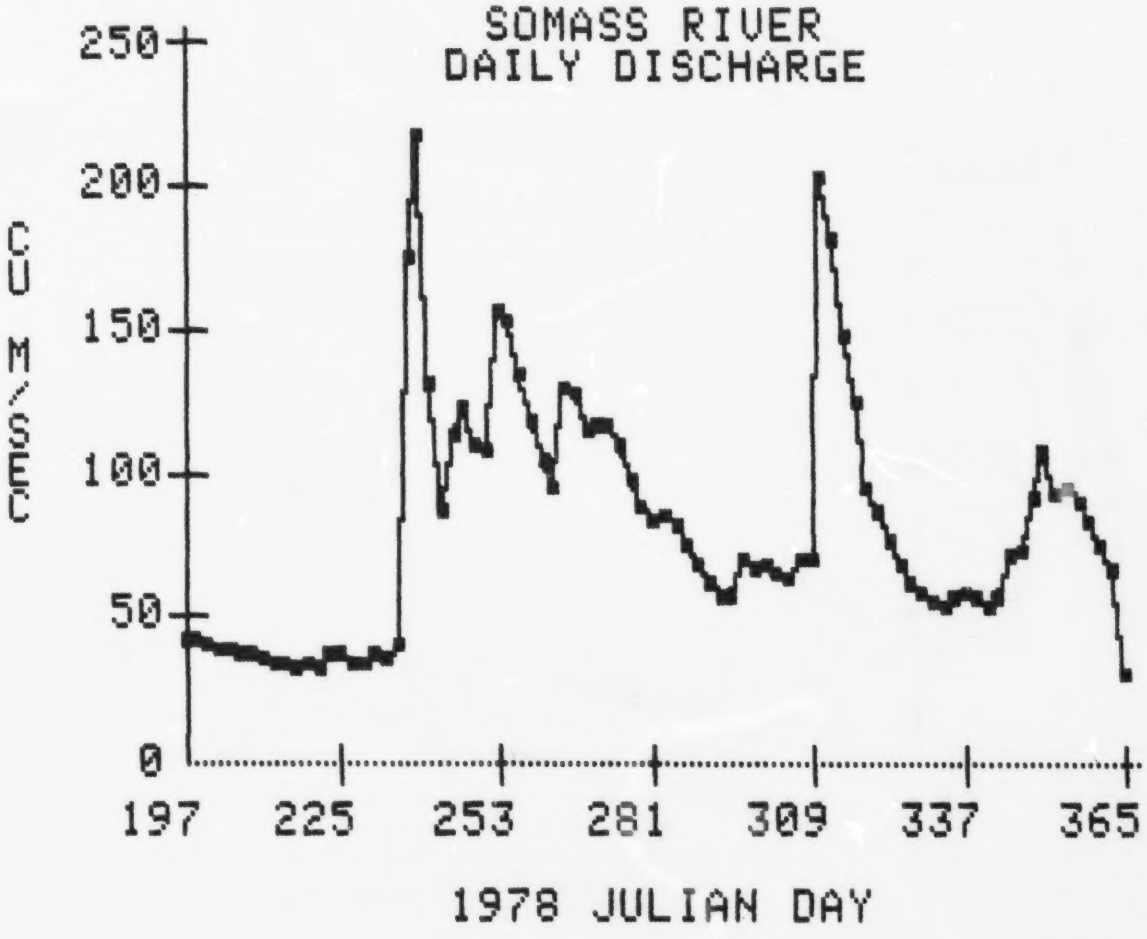

Fig. B4-78-R. Somass River daily discharge (cu m/sec); 1978.

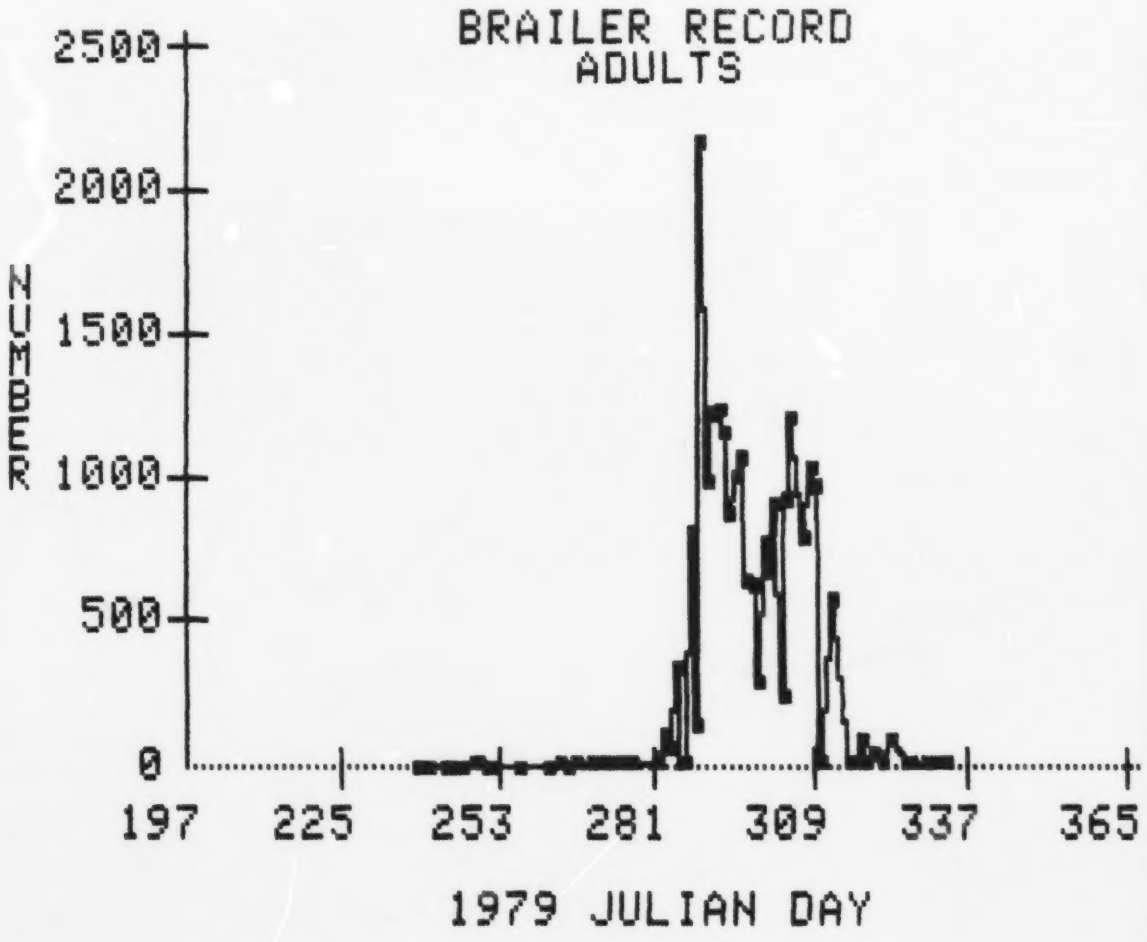

Fig. B4-79-L. Adult returns per day to brailer; 1979.

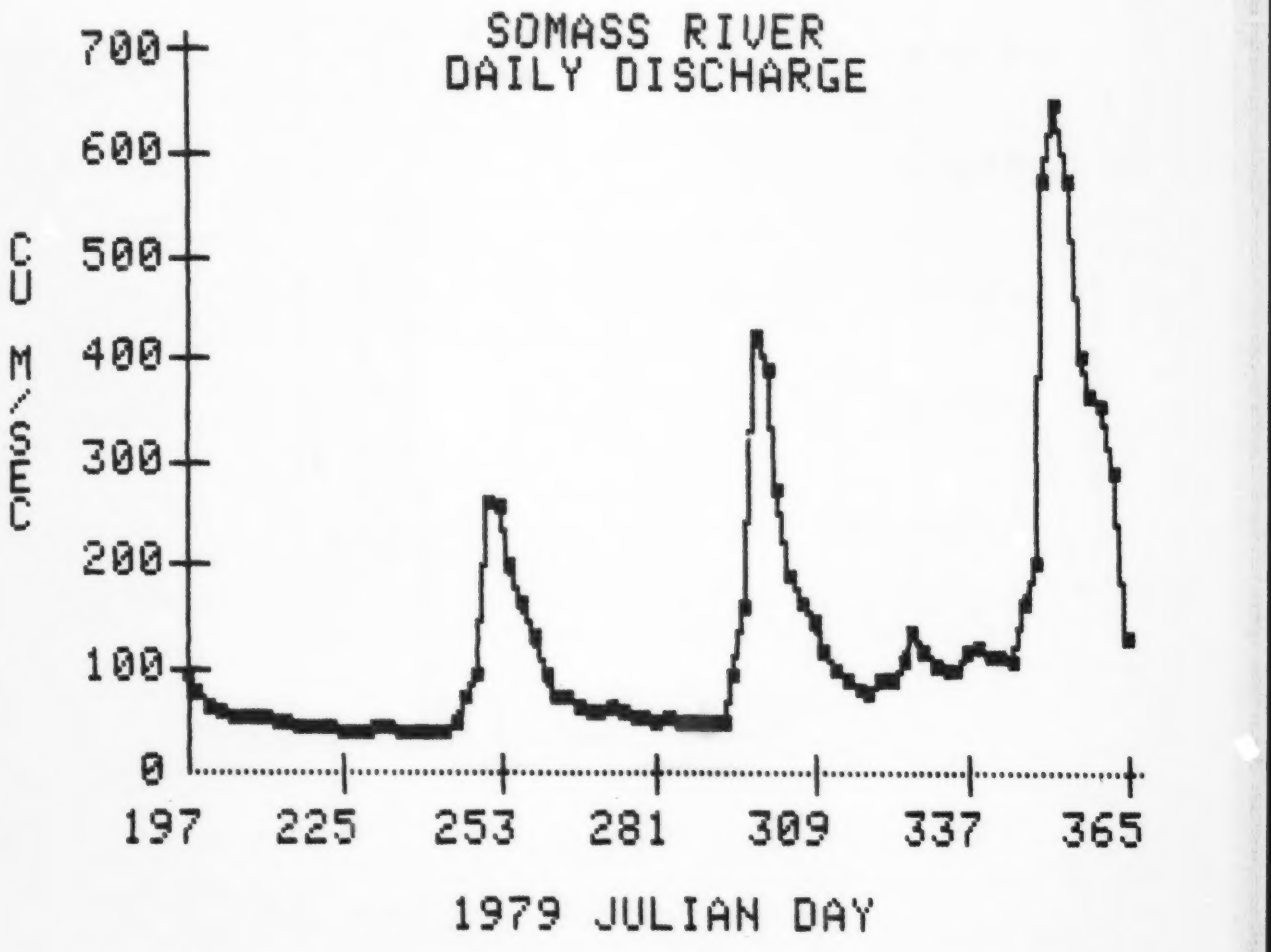

Fig. B4-79-R. Somass River daily discharge (cu m/sec); 1979.

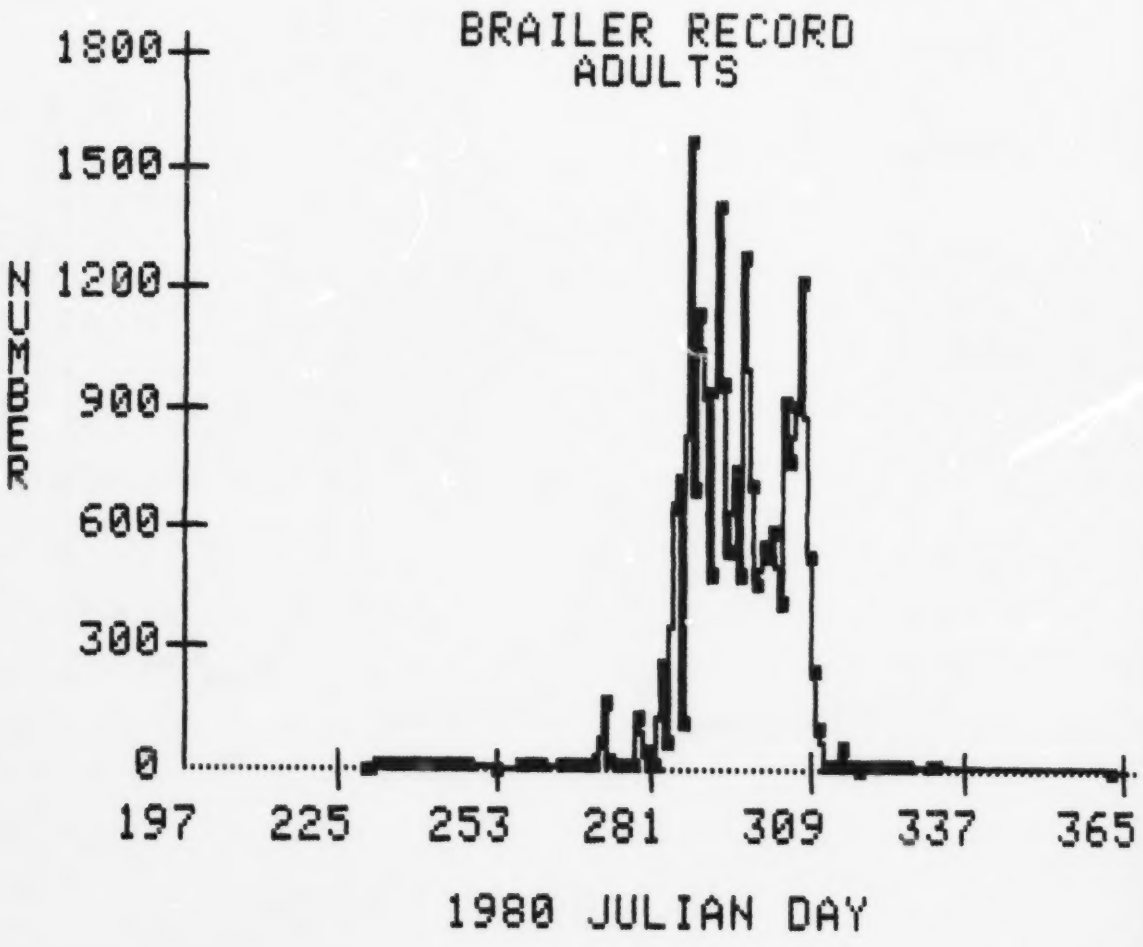

Fig. B4-80-L. Adult returns per day to brailer; 1980.

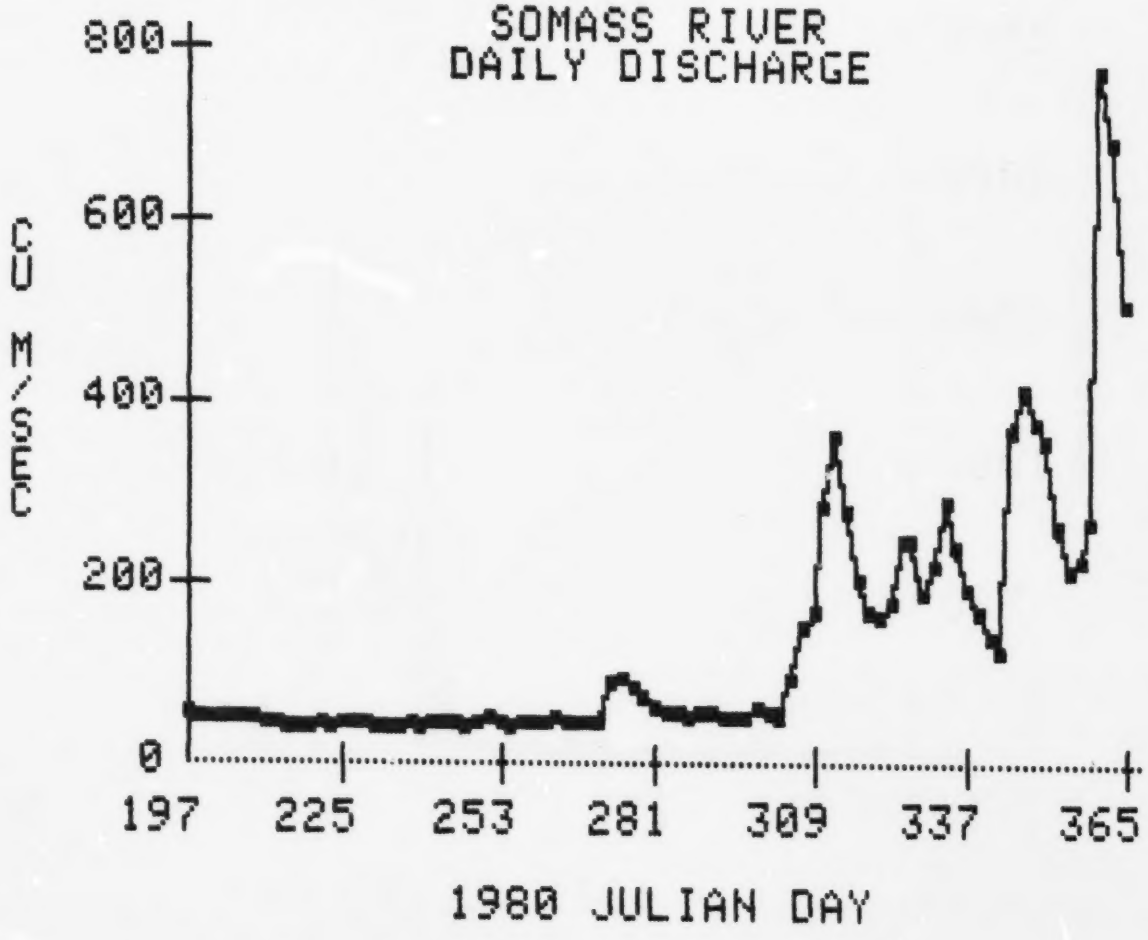

Fig. B4-80-R. Somass River daily discharge (cu m/sec); 1980.

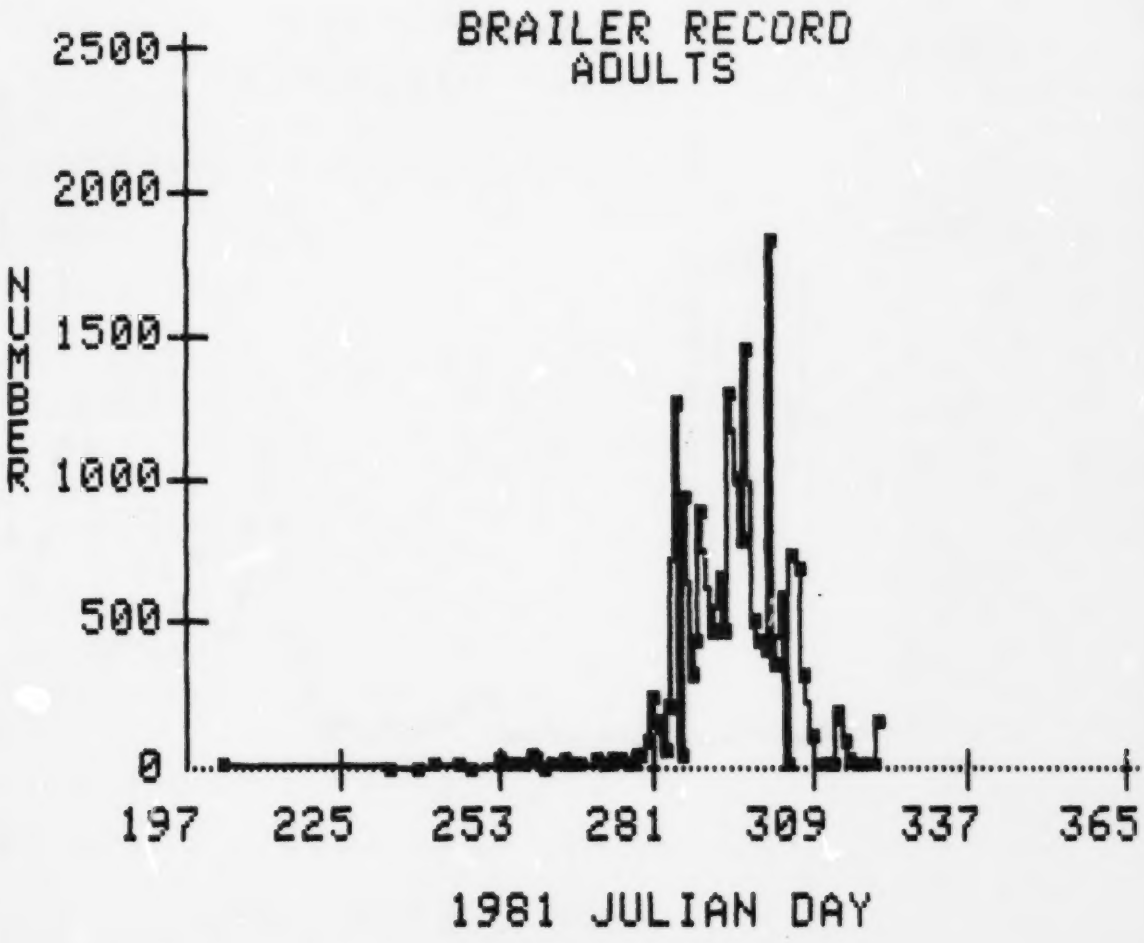

Fig. B4-81-L. Adult returns per day to brailer; 1980.

Fig. B4-81-R. Somass River daily discharge not available for 1981 at time of this publication.

FIG. B5

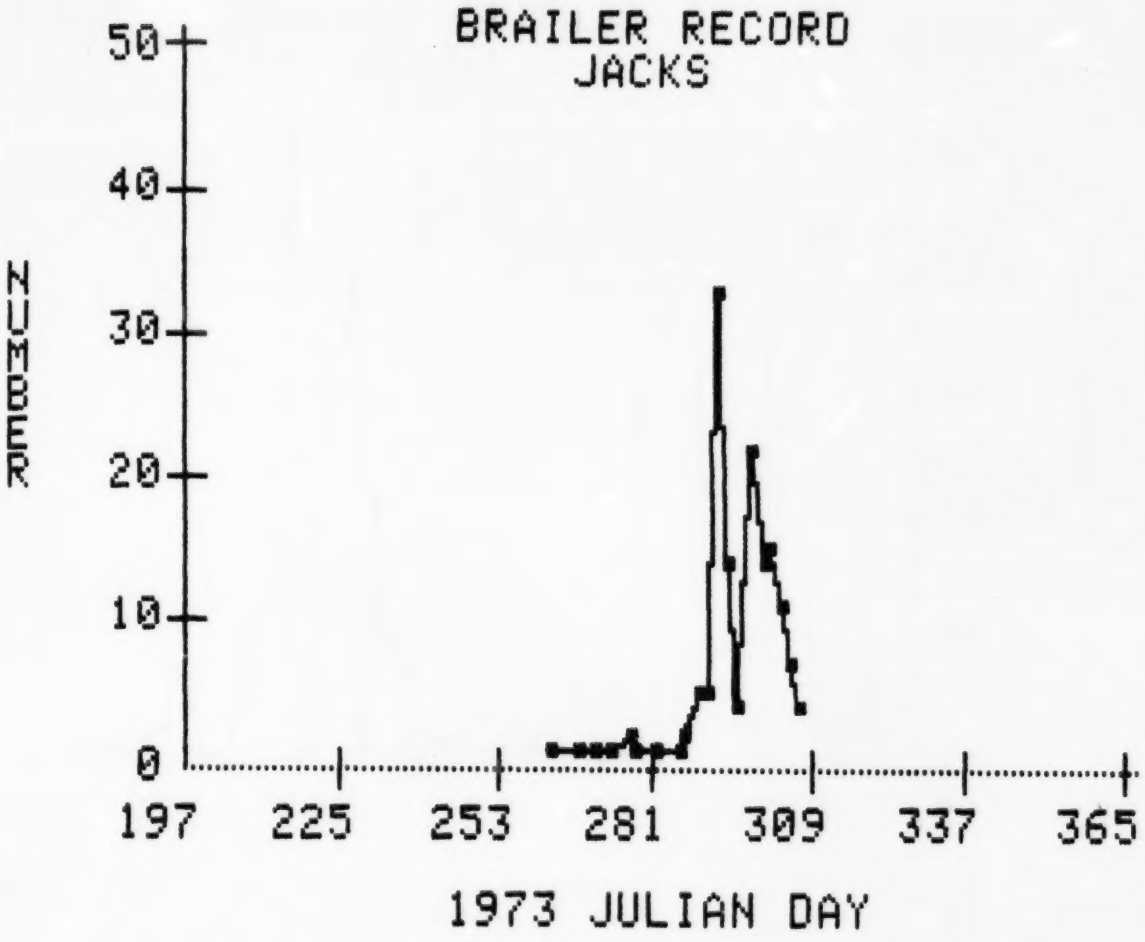

Fig. B5-73. Jack returns per day to the brailer; 1973.

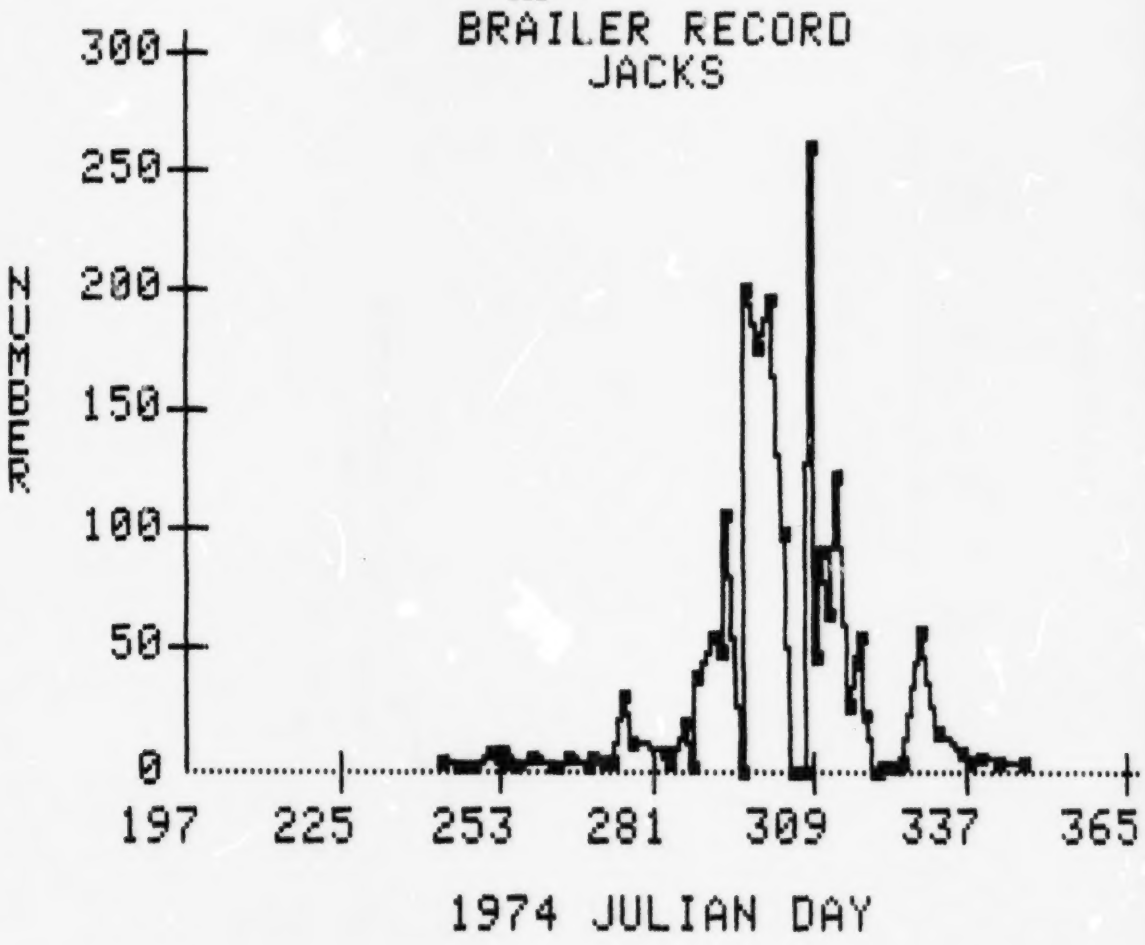

Fig. B5-74. Jack returns per day to the brailer; 1974.

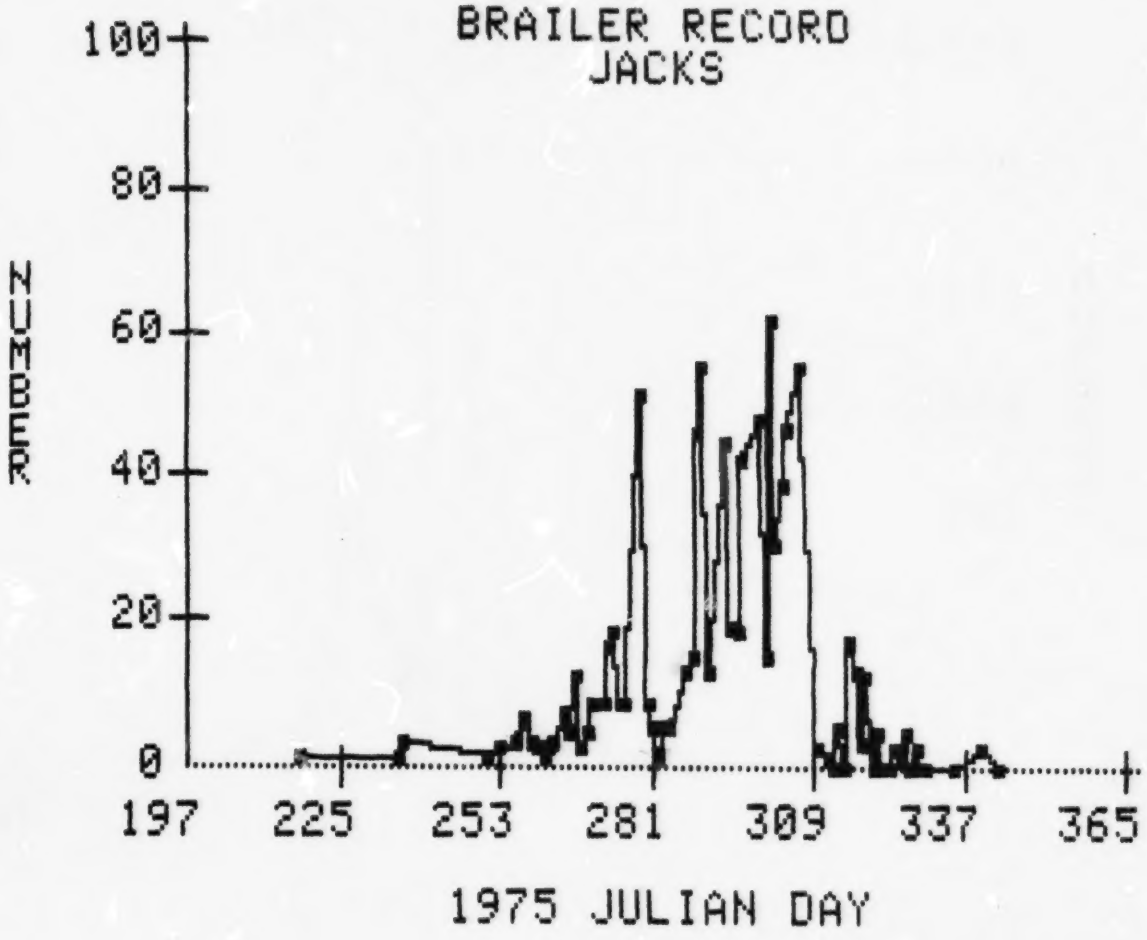

Fig. B5-75. Jack returns per day to the brailer; 1975.

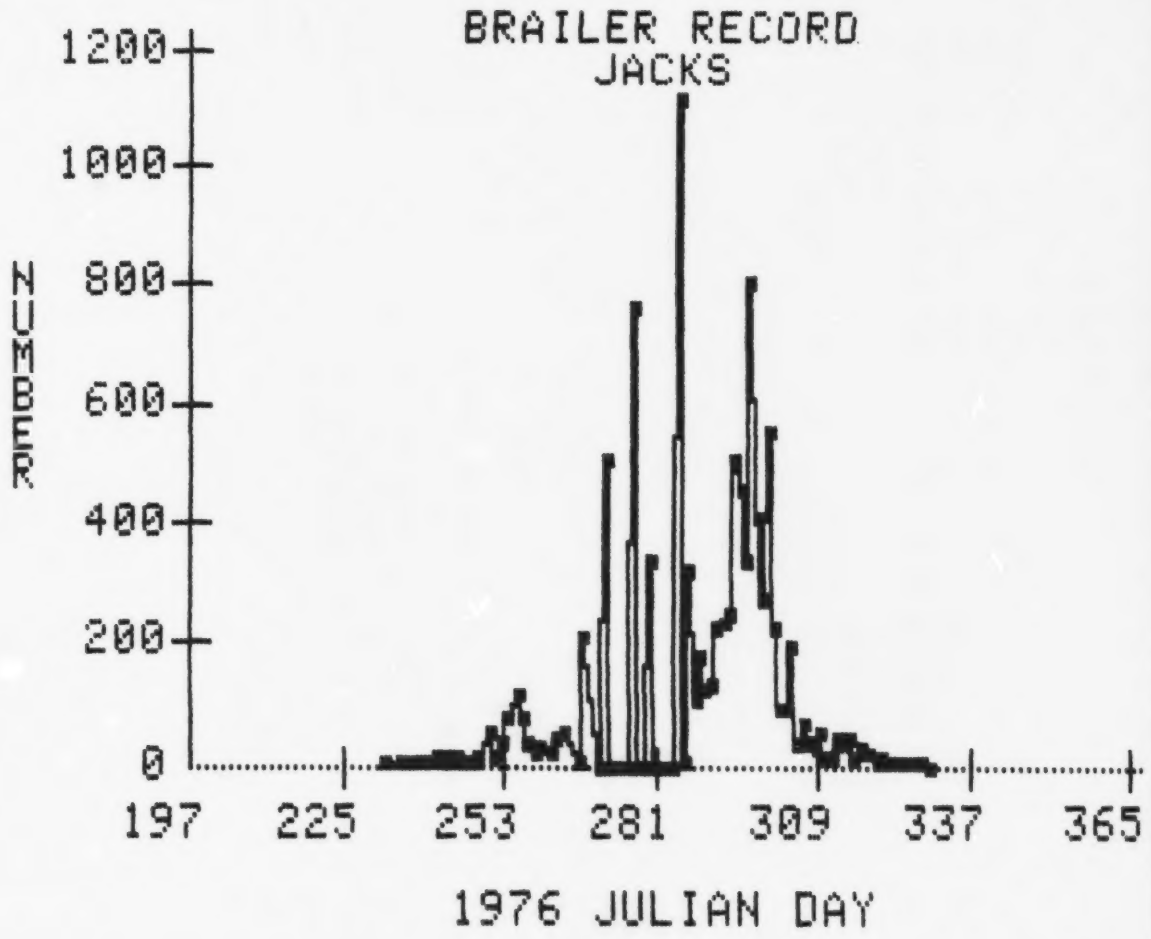

Fig. B5-76. Jack returns per day to the brailer; 1976.

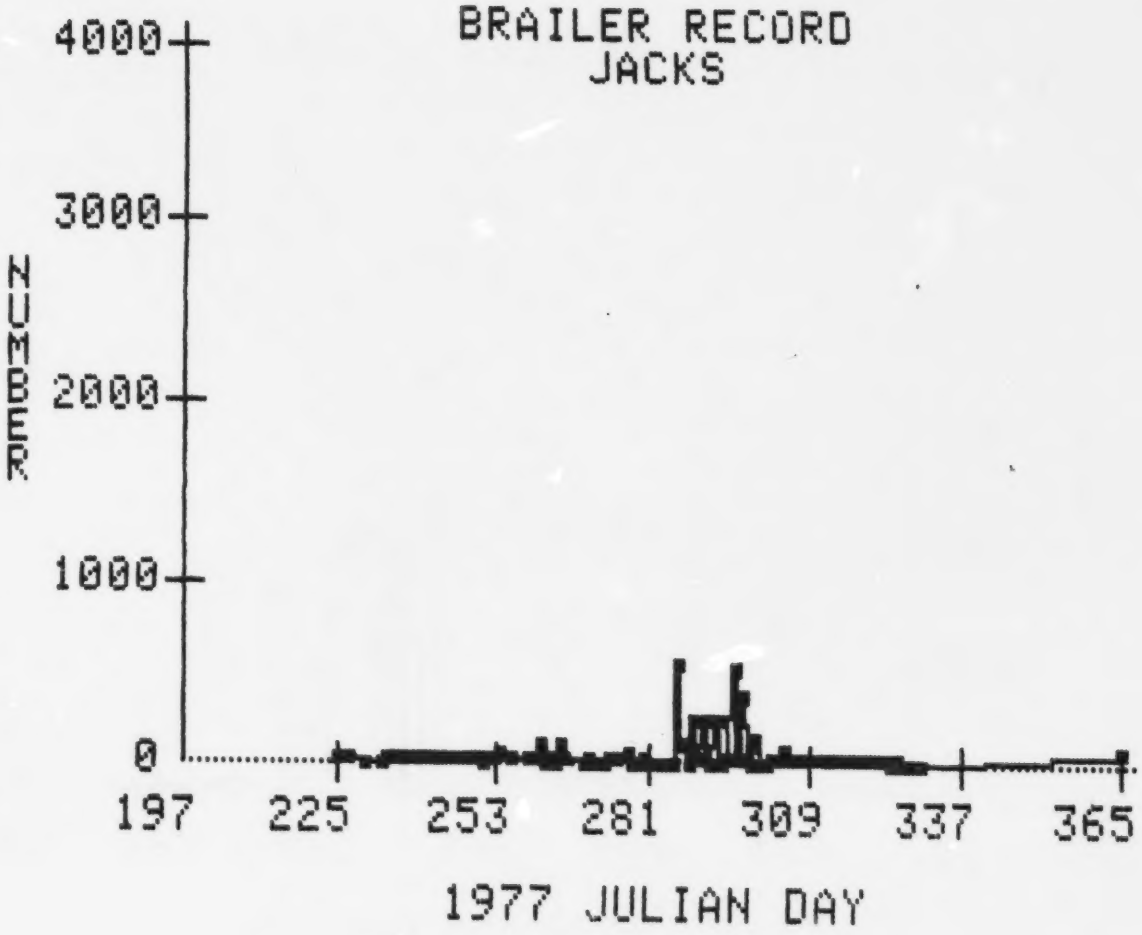

Fig. B5-77. Jack returns per day to the brailer; 1977.

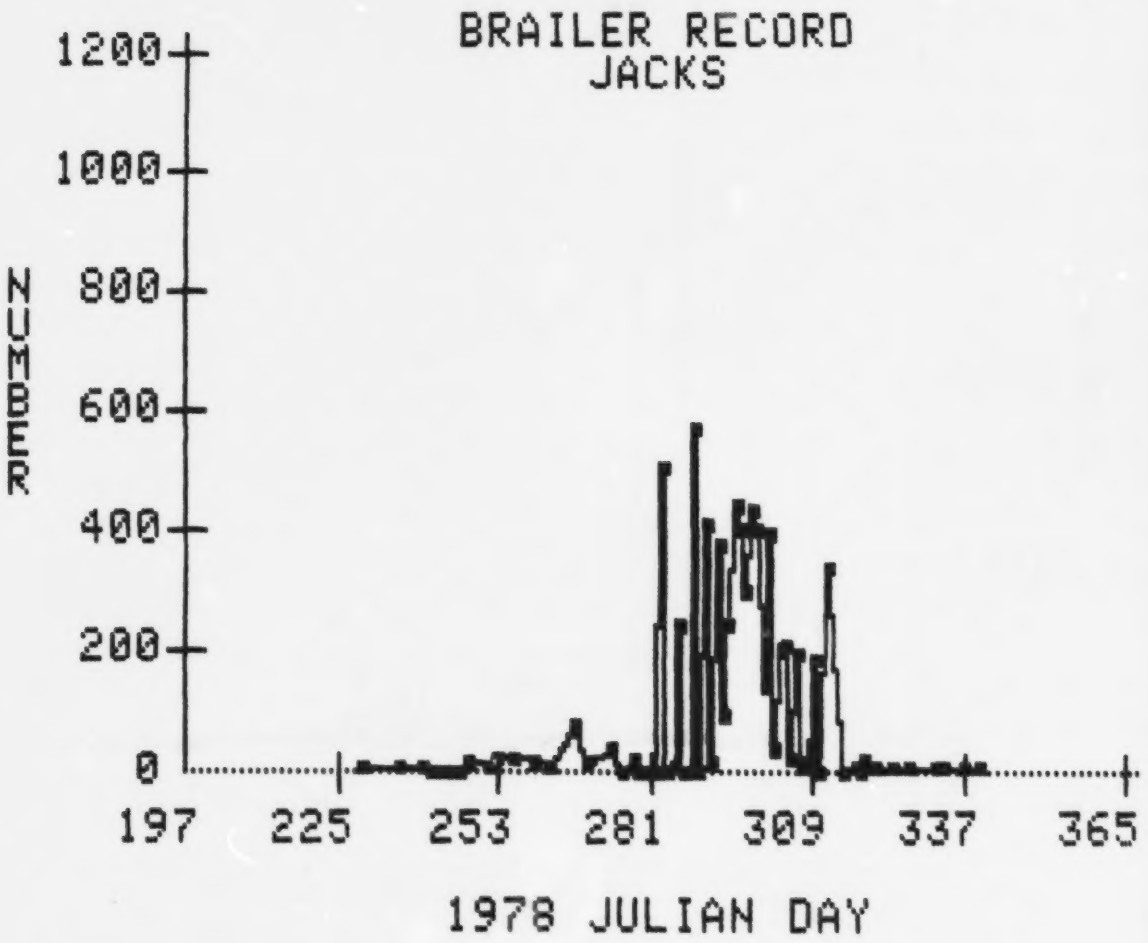

Fig. B5-78. Jack returns per day to the brailer; 1978.

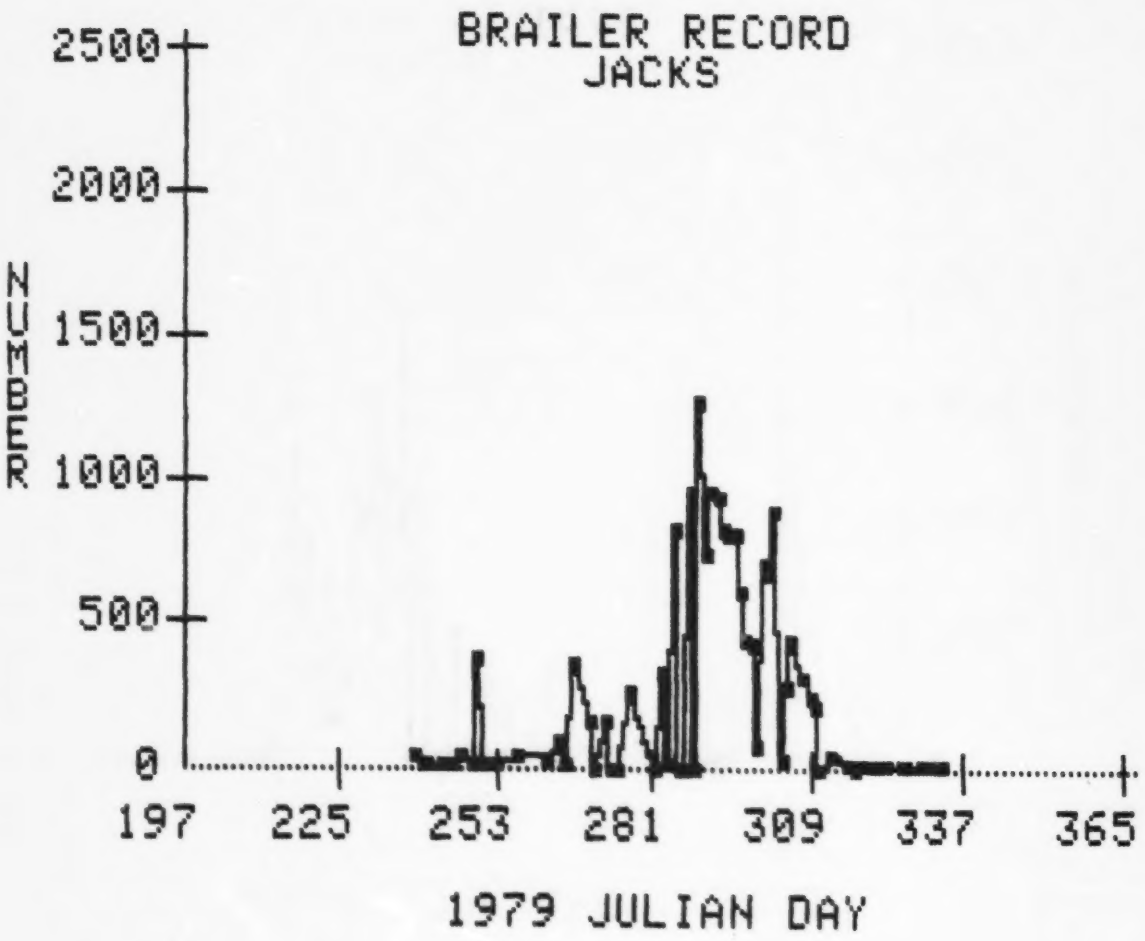

Fig. B5-79. Jack returns per day to the brailer; 1979.

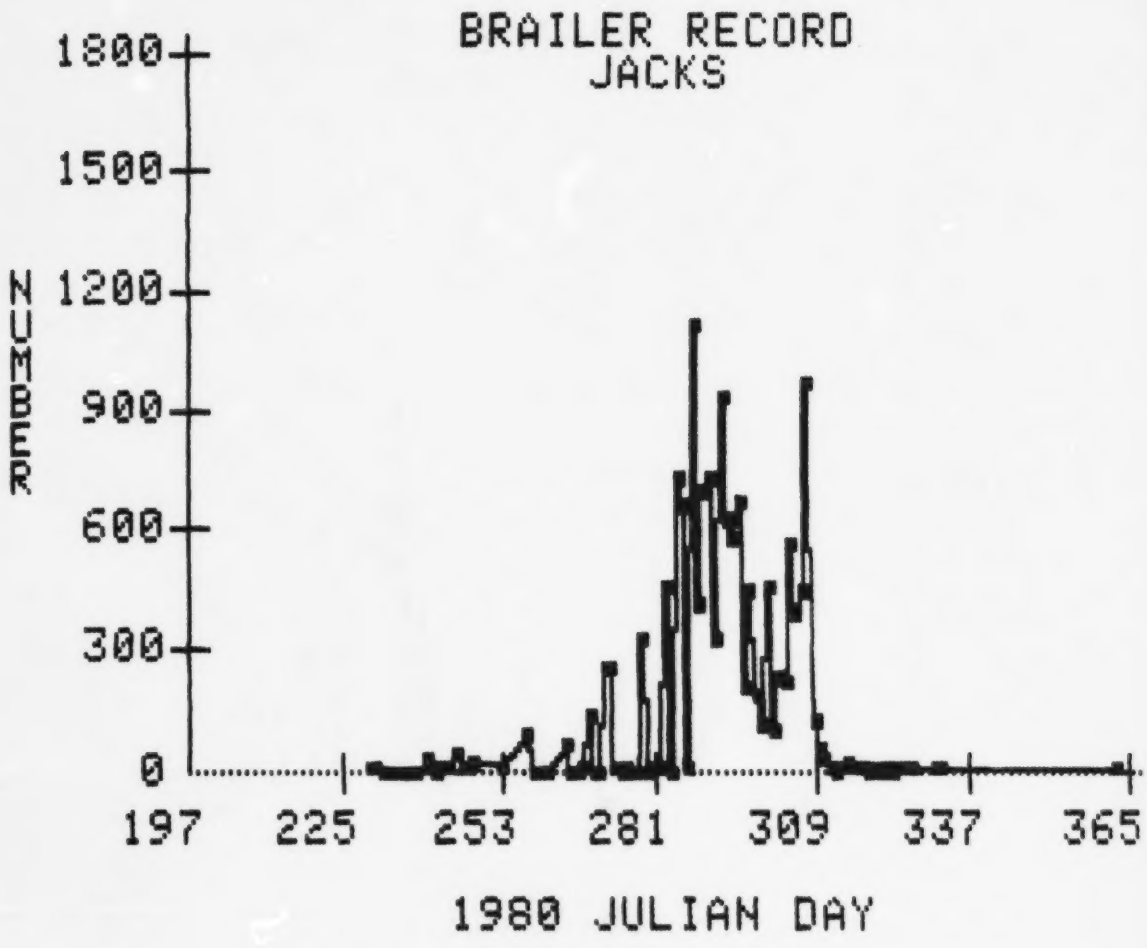

Fig. B5-80. Jack returns per day to the brailer; 1980.

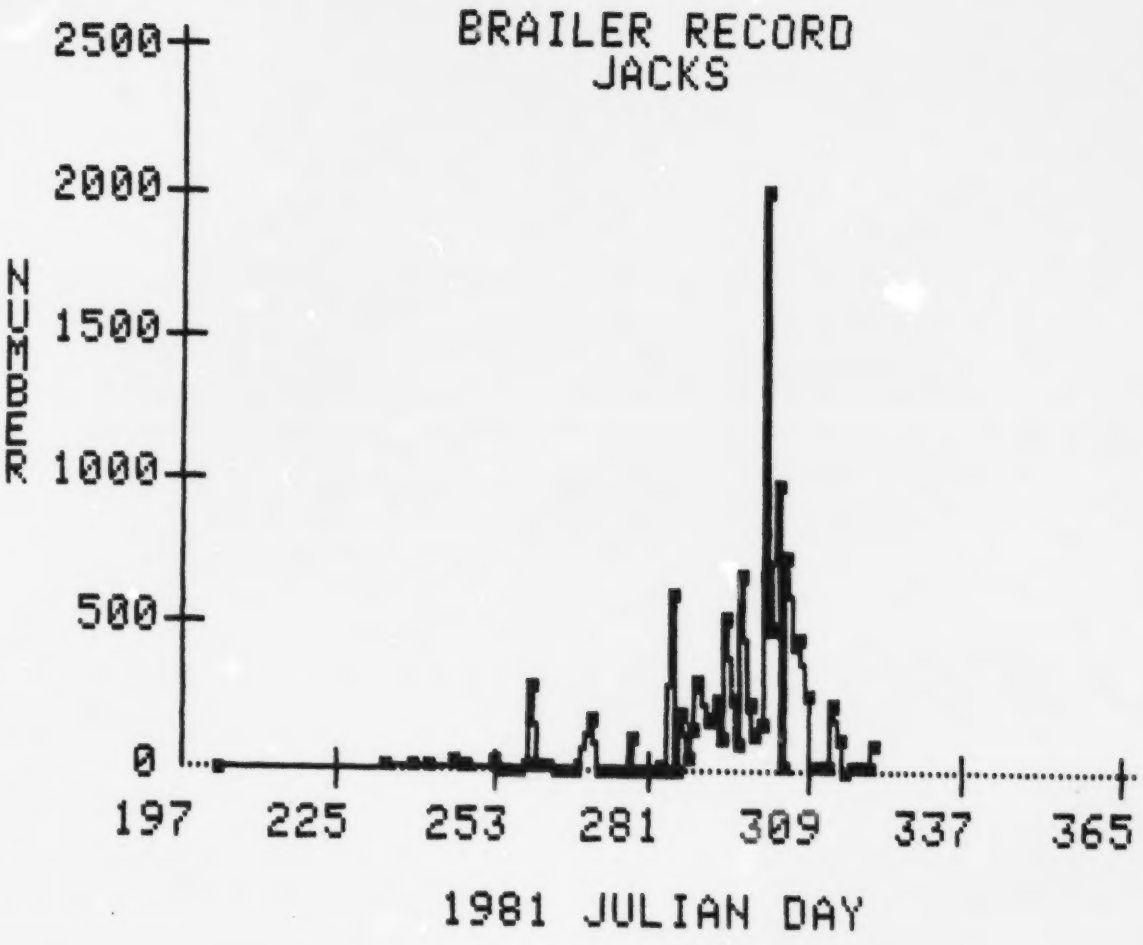

Fig. B5-81. Jack returns per day to the brailer; 1981.

FIG. B6

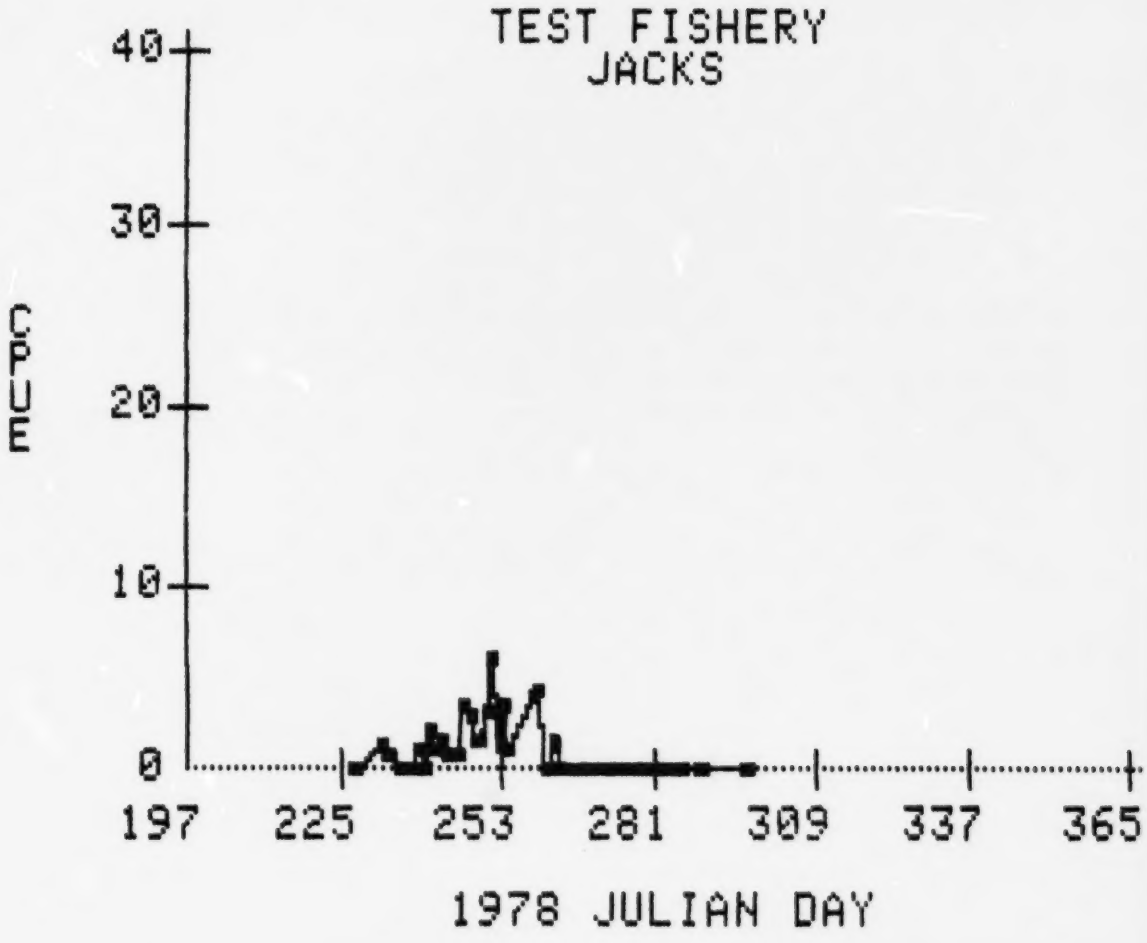

Fig. B6-78. Catch of jacks in test fishery; 1978. CPUE is in fish per hour.

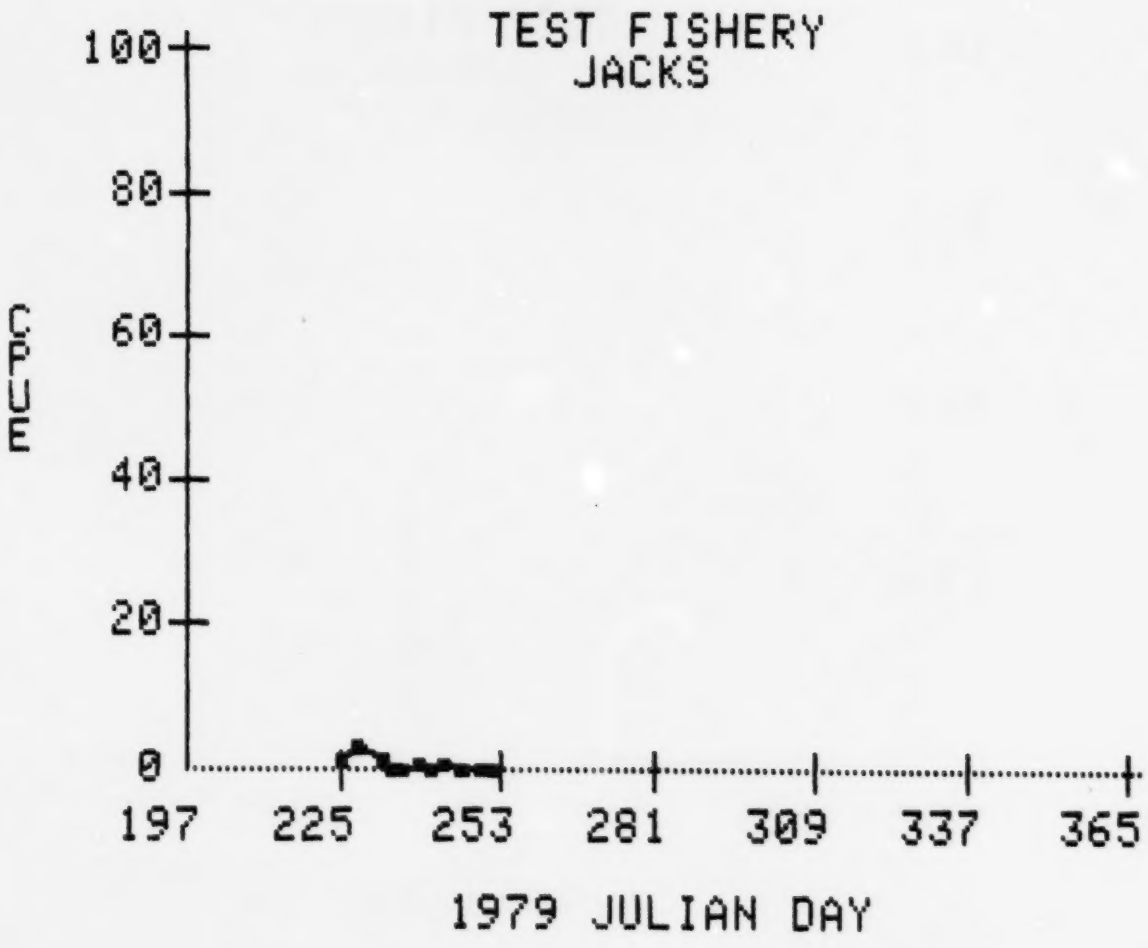

Fig. B6-79. Catch of jacks in test fishery; 1979. CPUE is in fish per hour.

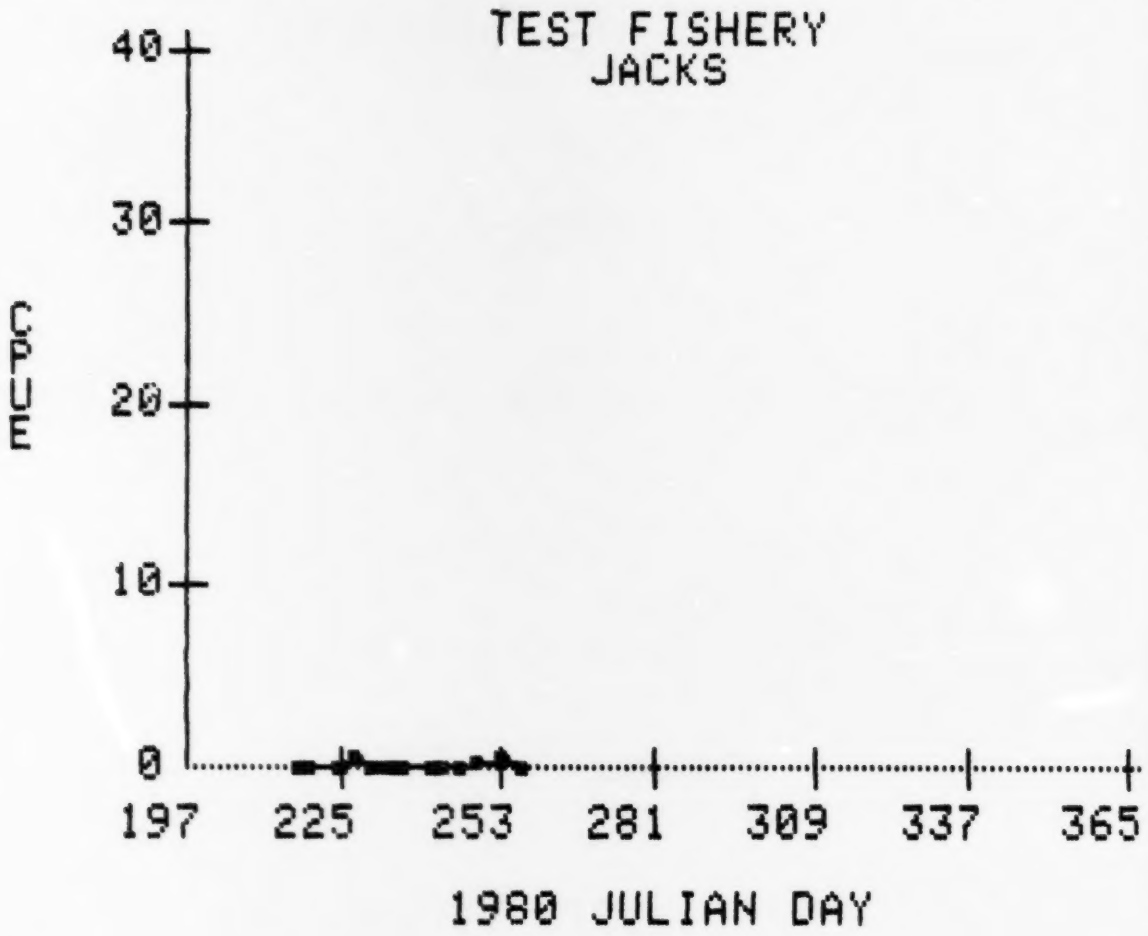

Fig. B6-80. Catch of jacks in test fishery; 1980. CPUE is in fish per hour.

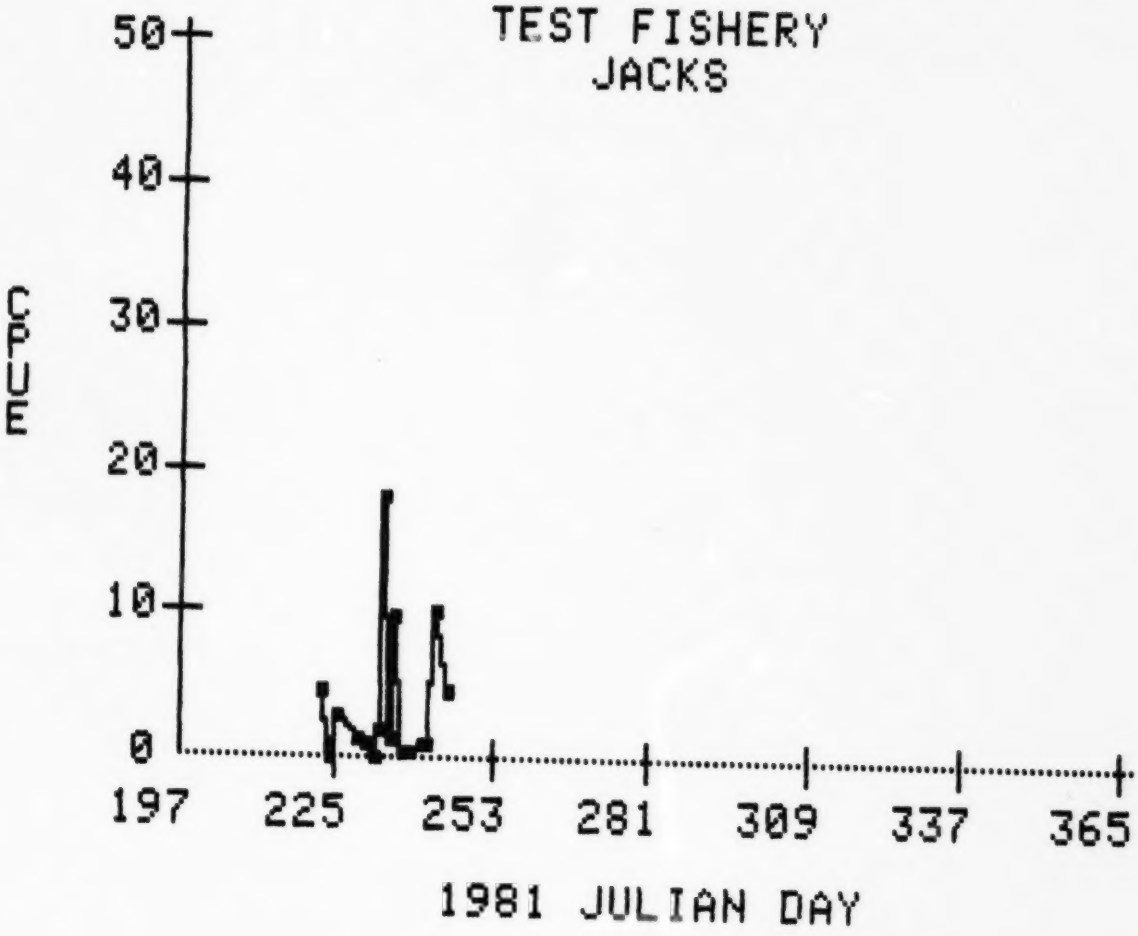

Fig. B6-81. Catch of jacks in test fishery; 1981. CPUE is in fish per hour.

FIG. B7

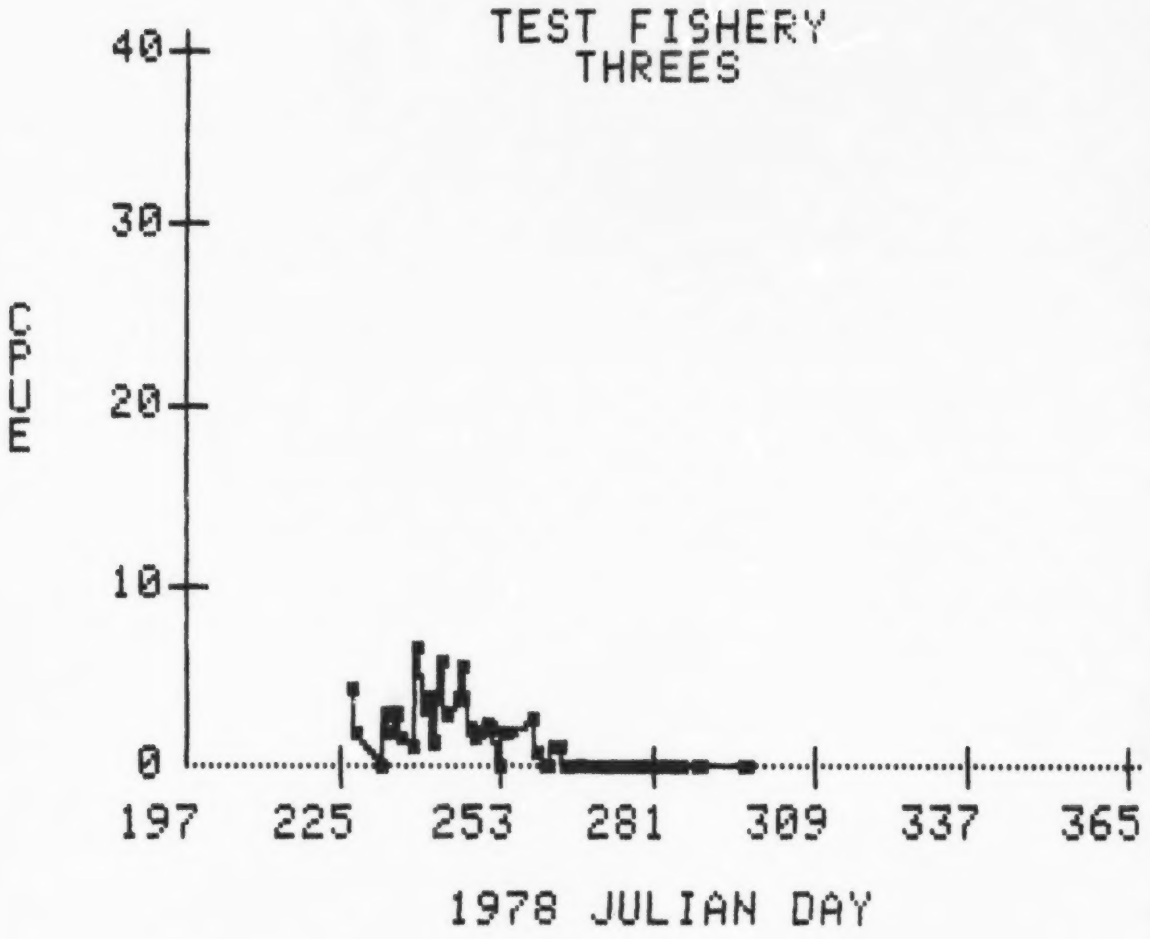

Fig. B7-78-L. Catch of age three fish in test fishery; 1978. CPUE is in fish per hour.

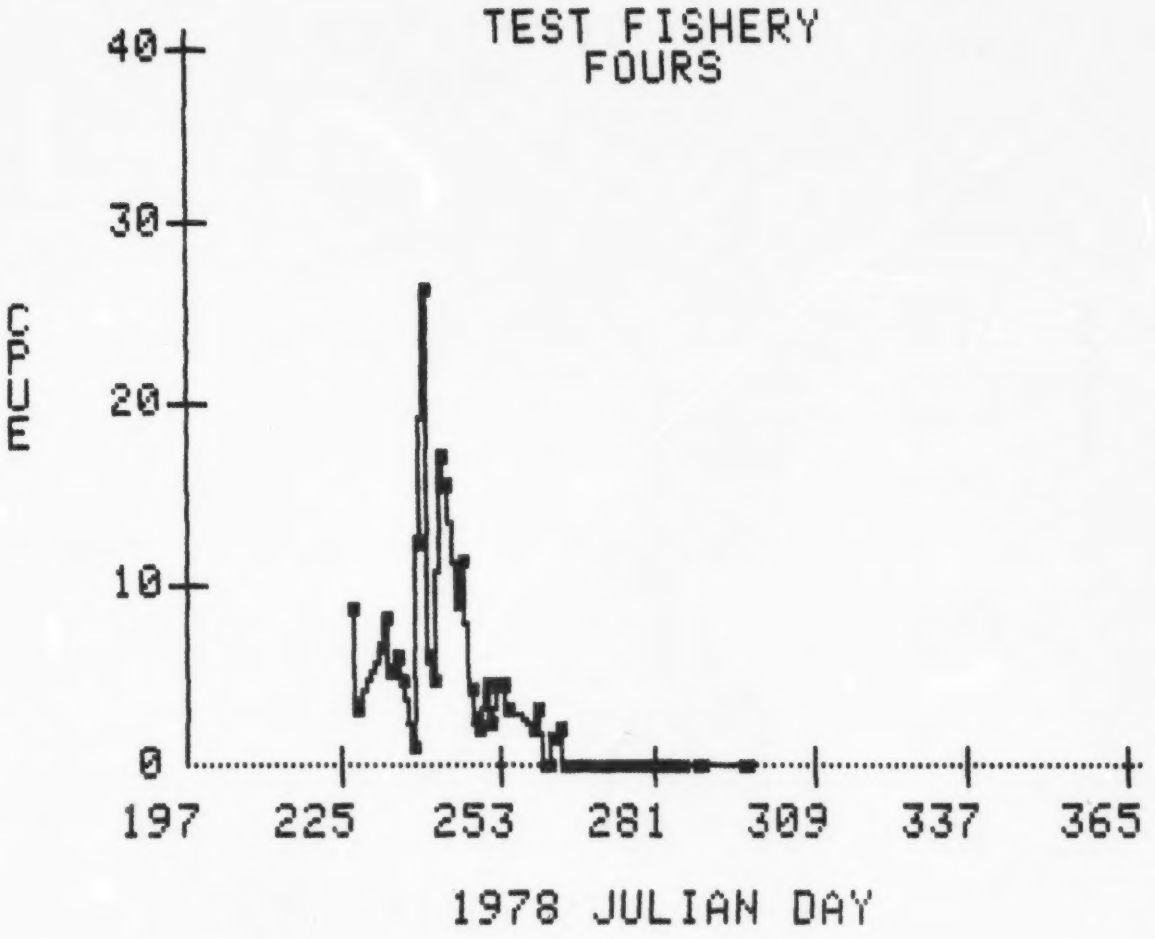

Fig. B7-78-R. Catch of age four fish in test fishery; 1978. CPUE is in fish per hour.

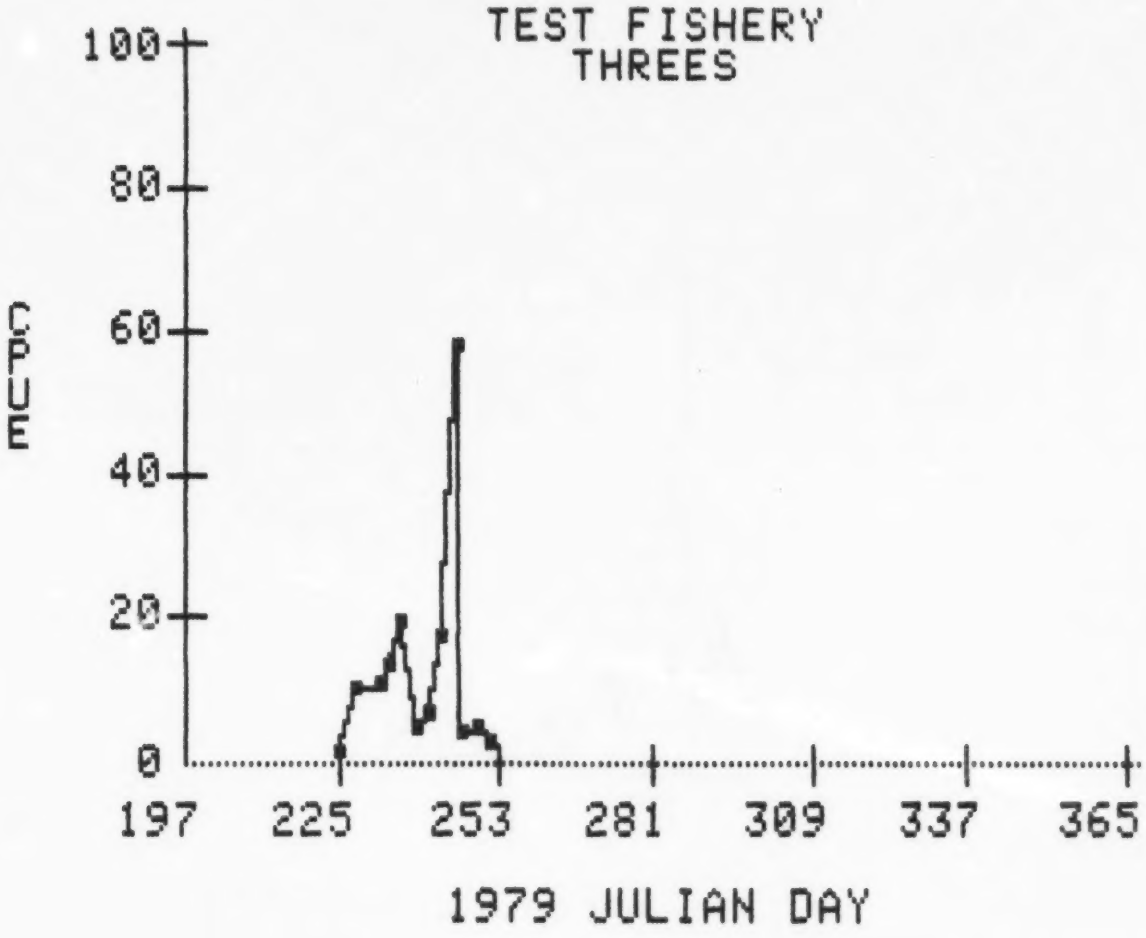

Fig. B7-79-L. Catch of age three fish in test fishery; 1979. CPUE is in fish per hour.

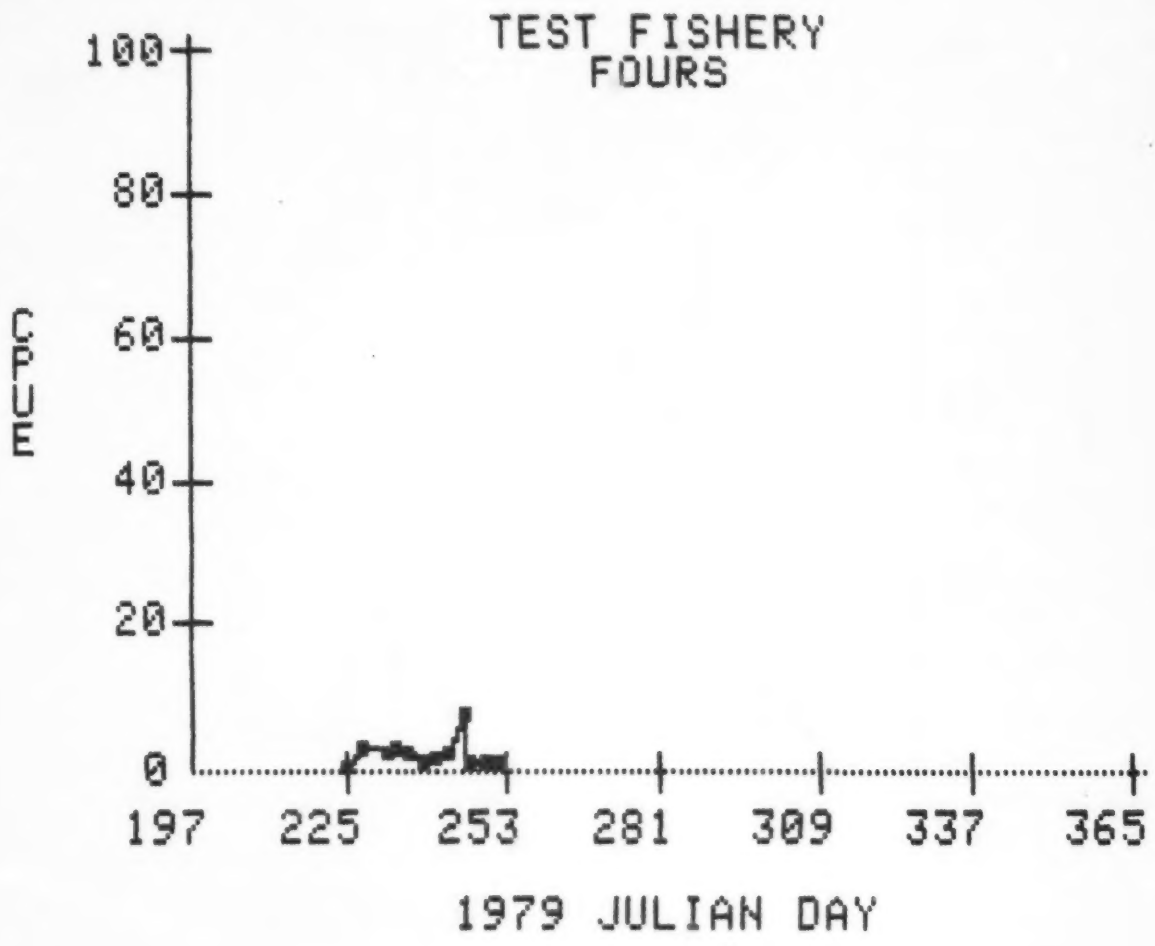

Fig. B7-79-R. Catch of age four fish in test fishery; 1979. CPUE is in fish per hour.

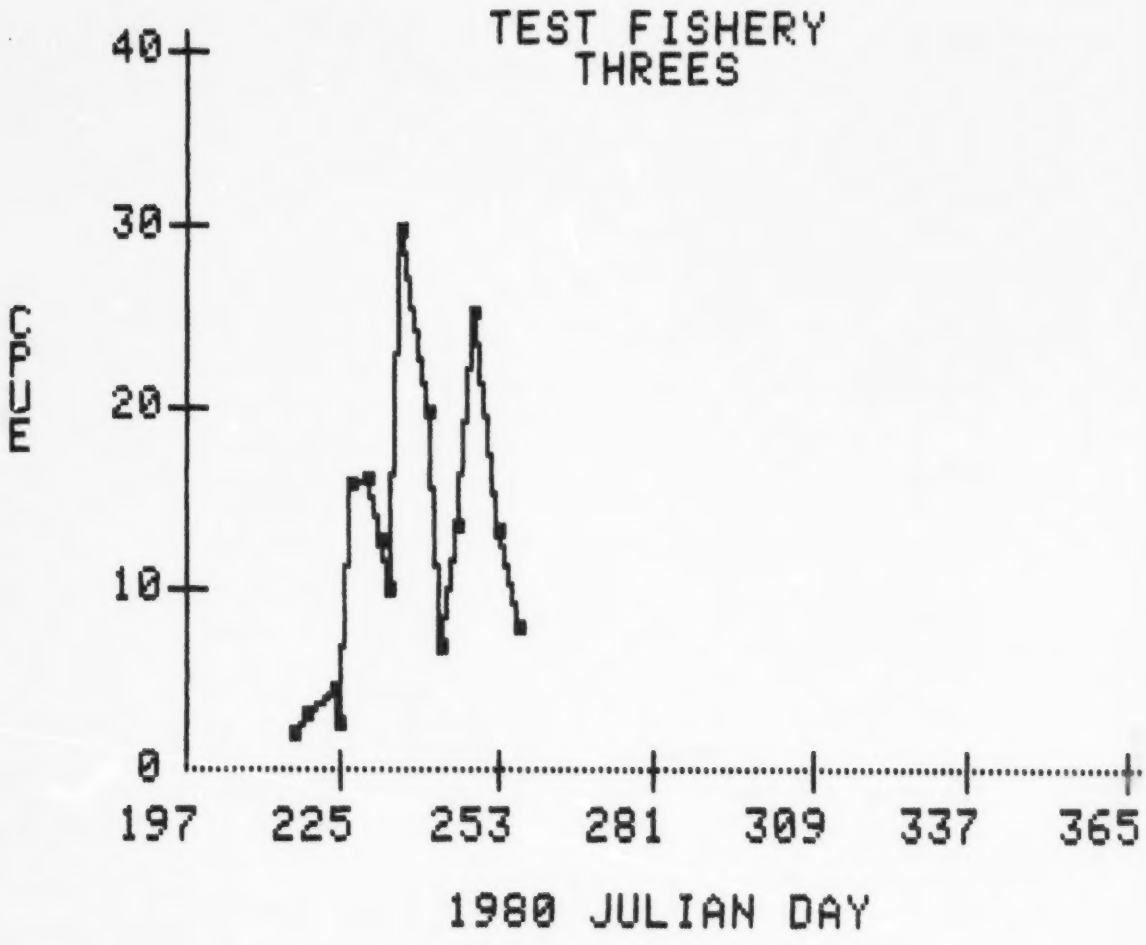

Fig. B7-80-L. Catch of age three fish in test fishery; 1980. CPUE is in fish per hour.

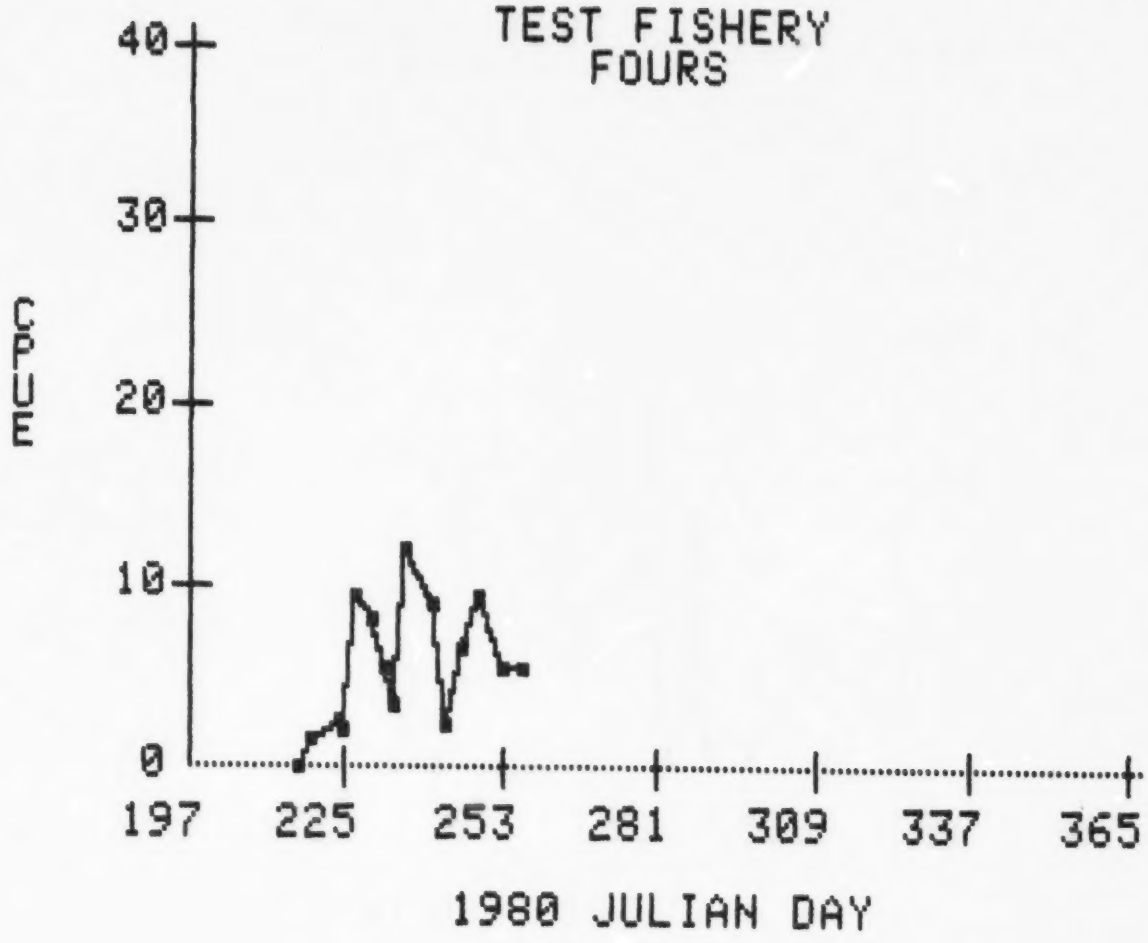

Fig. B7-80-R. Catch of age four fish in test fishery; 1980. CPUE is in fish per hour.

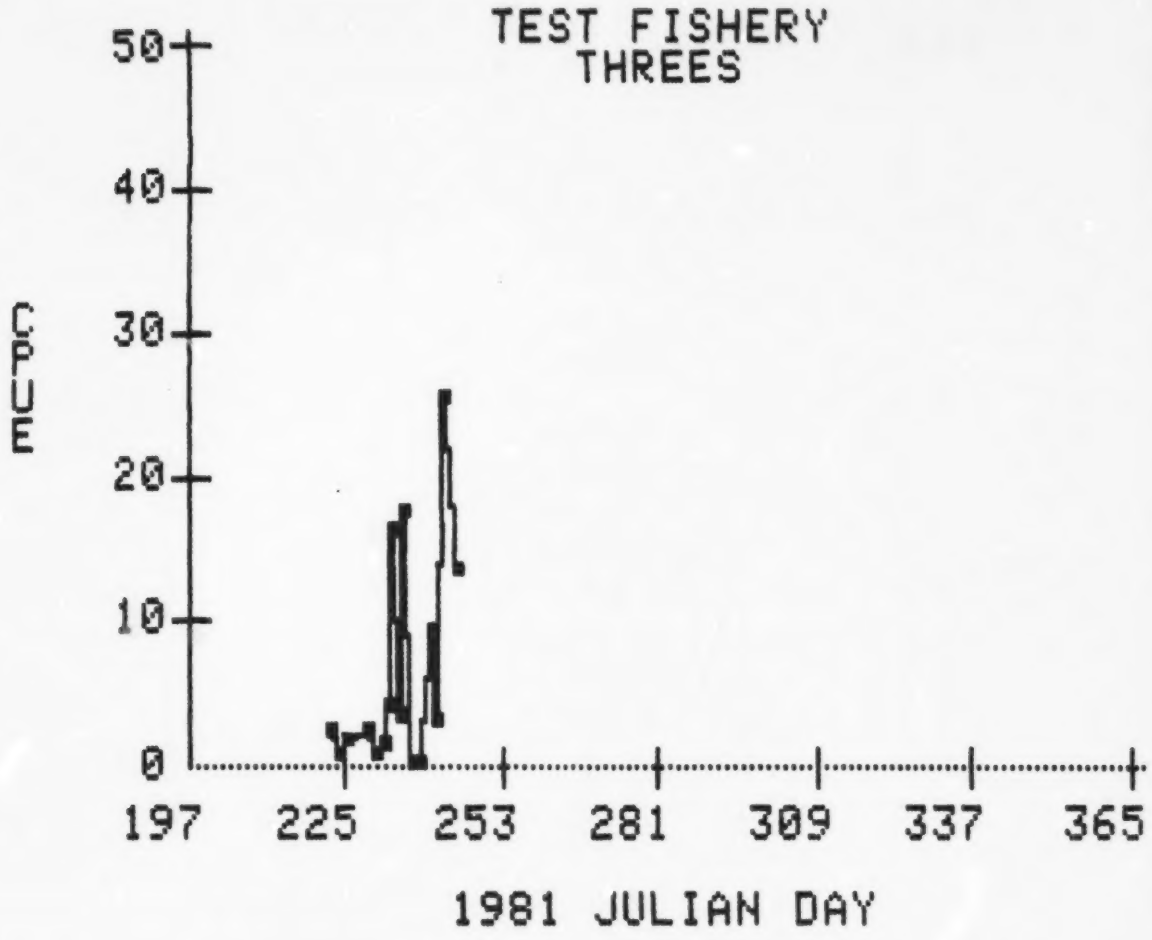

Fig. B7-81-L. Catch of age three fish in test fishery; 1981. CPUE is in fish per hour.

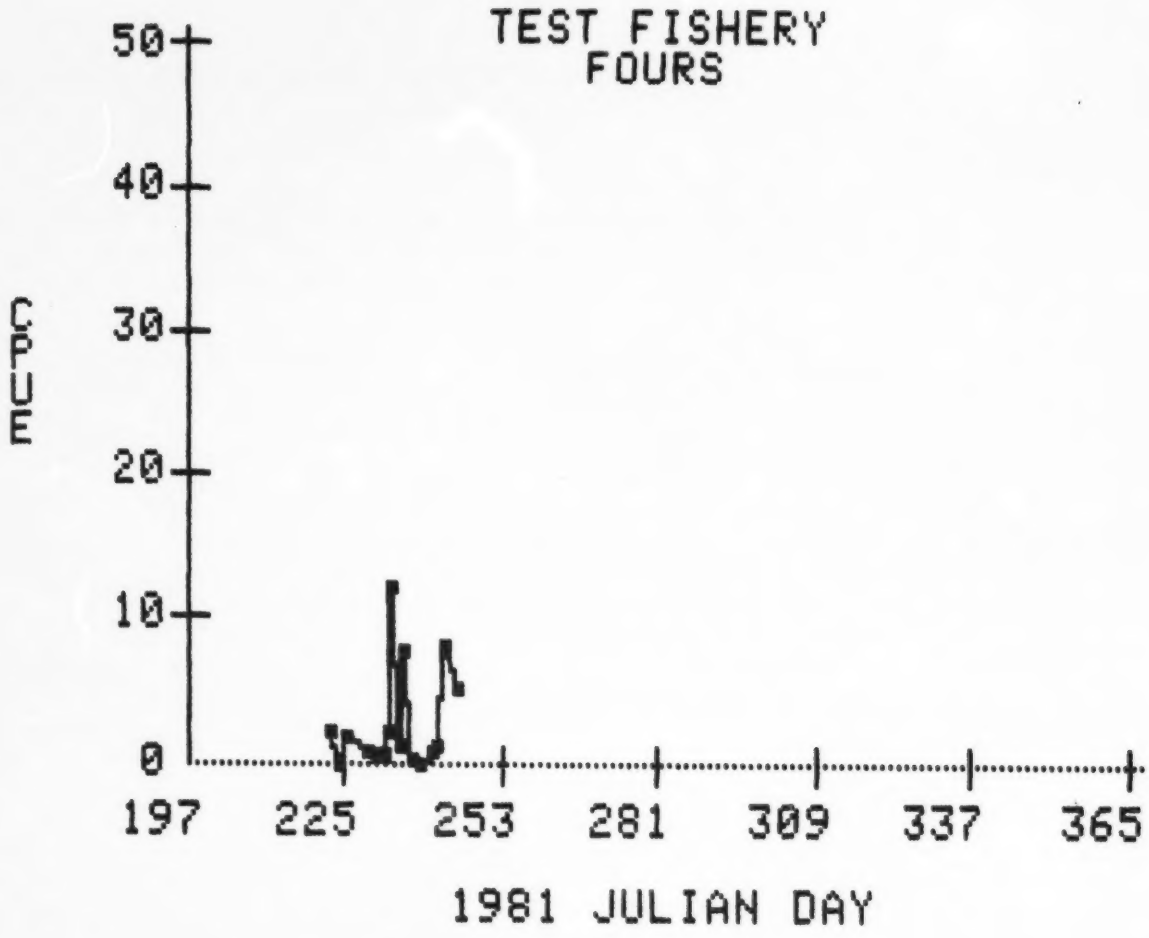

Fig. B7-81-R. Catch of age four fish in test fishery; 1981. CPUE is in fish per hour.

Appendix C. Model reconstructions for 1978-81.

		Page
Fig. C1.	Model reconstructions with a 10-day pool time and parameters shown in Table 5; daily run to fishery and daily escapement.	139
Fig. C2.	Model reconstructions with a 10-day pool time and parameters shown in Table 5; cumulative run, pool size and cumulative escapement.	145

FIG. C1

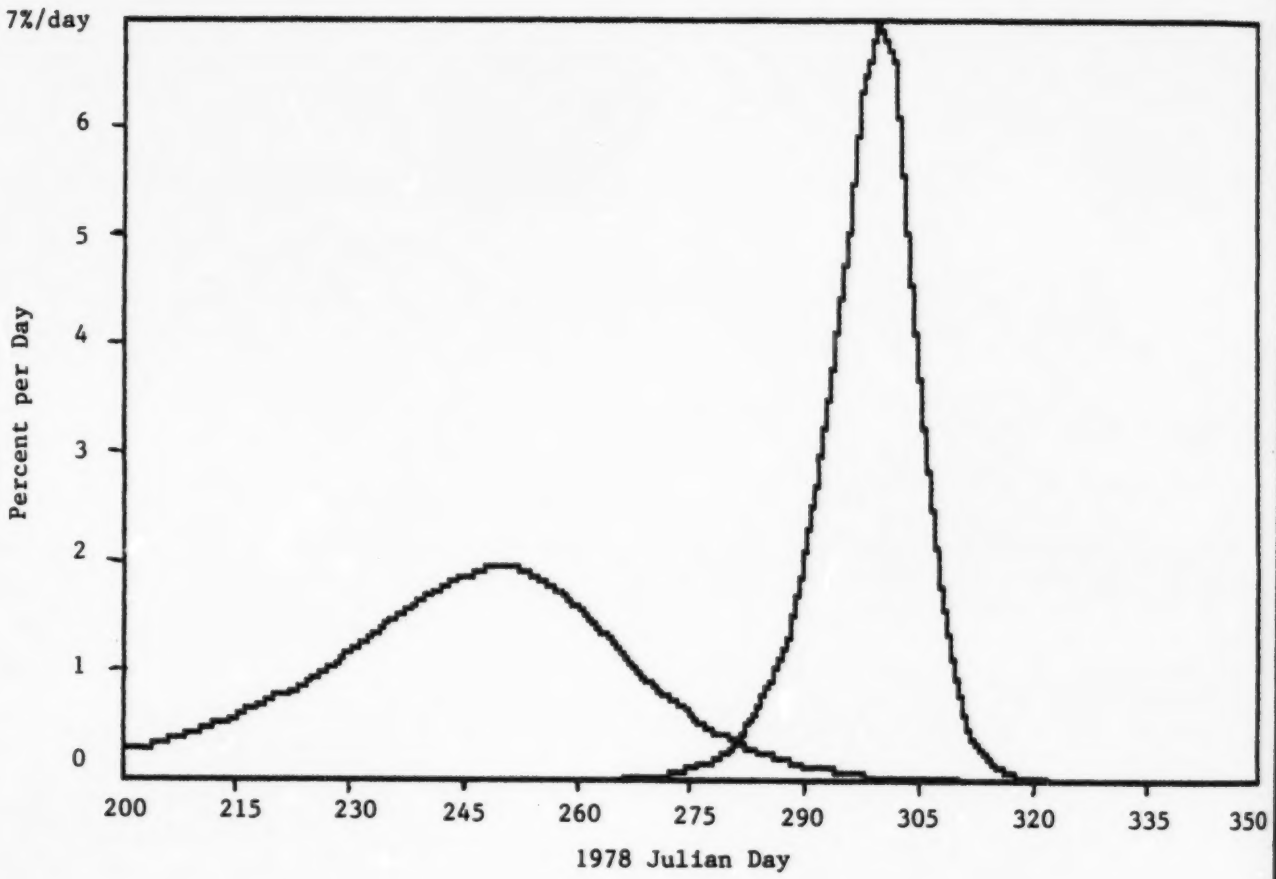

Fig. C1-78. Model reconstruction for 1978 adults with a 10-day pool time and parameters shown in Table 7. Daily run to the fishery and daily escapement are expressed as percentages of the total annual run arriving per day.

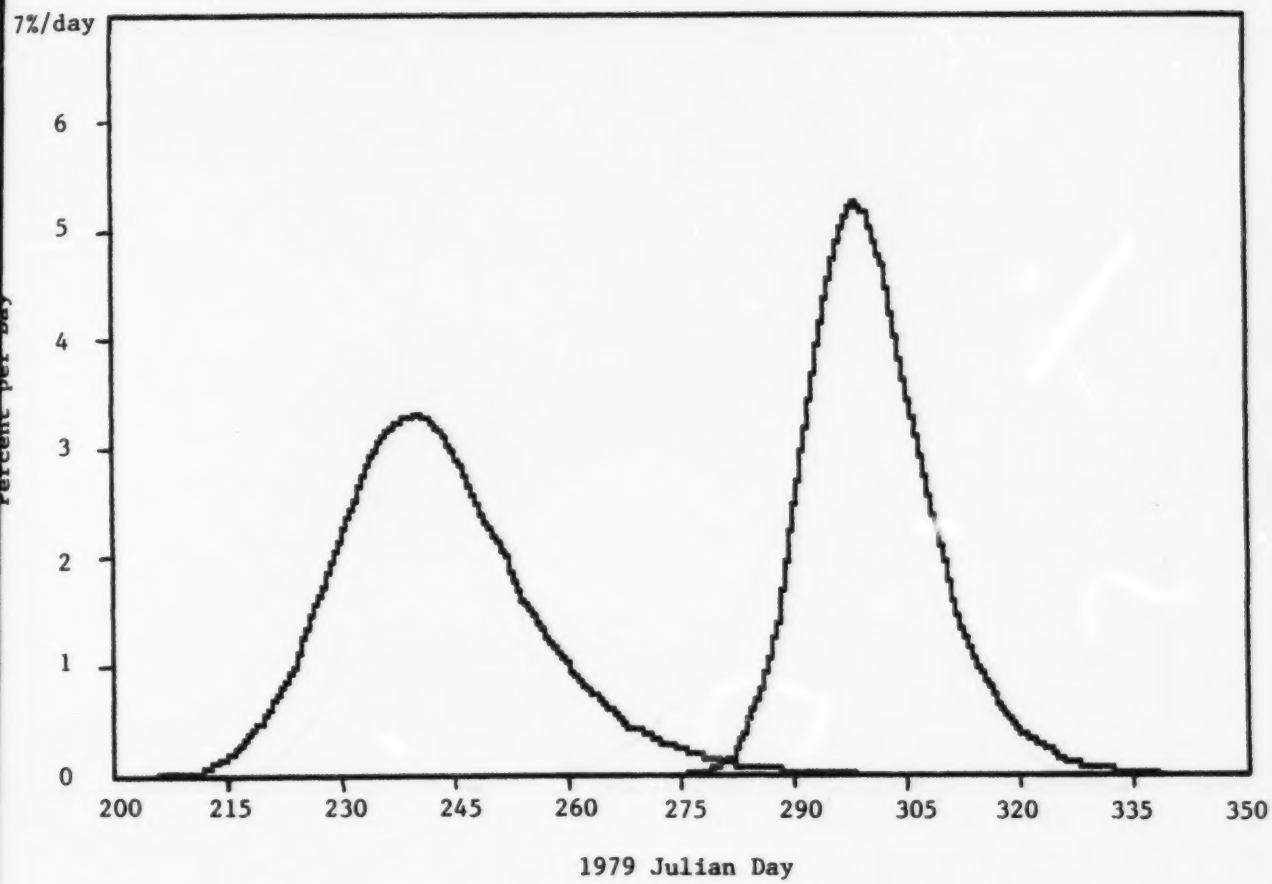

Fig. C1-79. Model reconstruction for 1979 adults with a 10-day pool time and parameters shown in Table 7. Daily run to the fishery and daily escapement are expressed as percentages of the total annual run arriving per day.

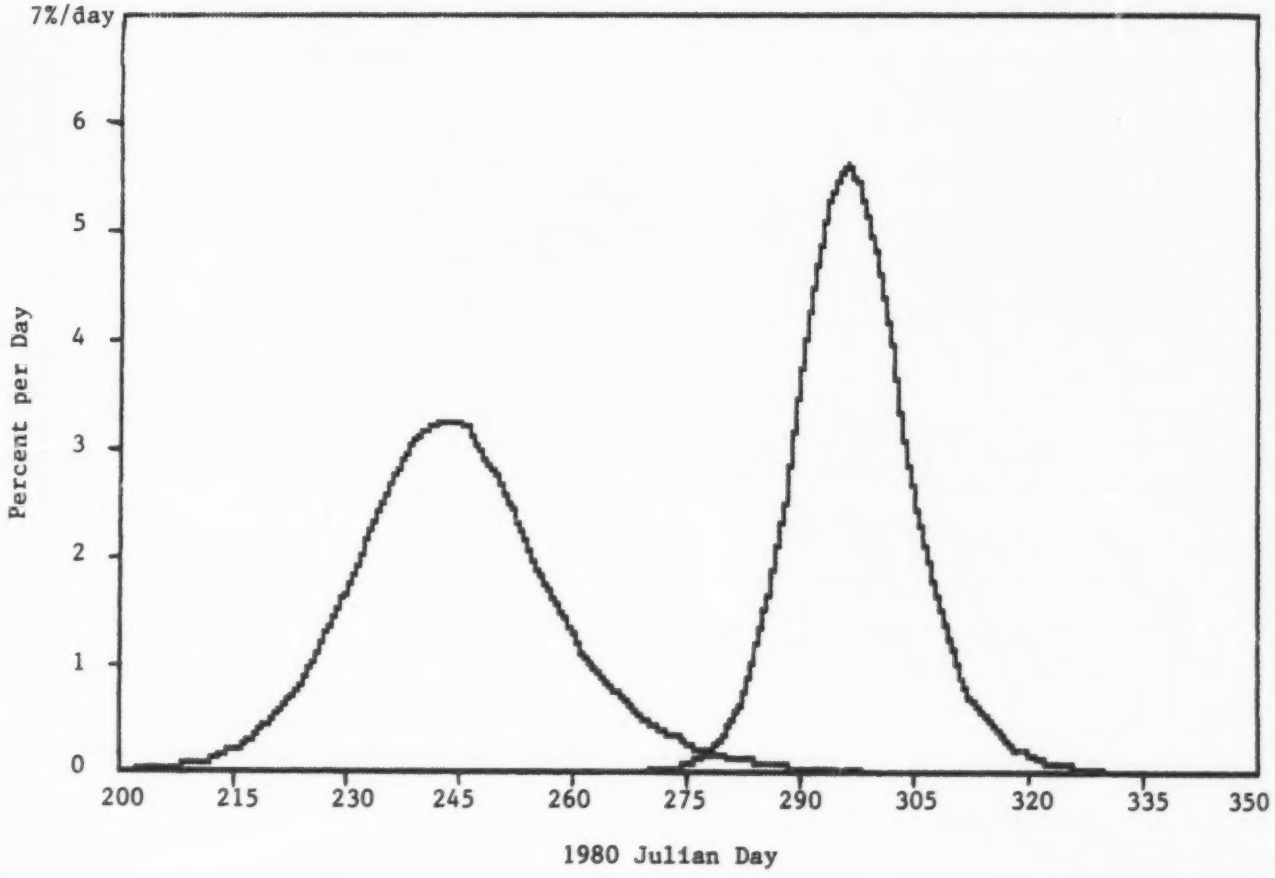

Fig. C1-80. Model reconstruction for 1980 adults with a 10-day pool time and parameters shown in Table 7. Daily run to the fishery and daily escapement are expressed as percentages of the total annual run arriving per day.

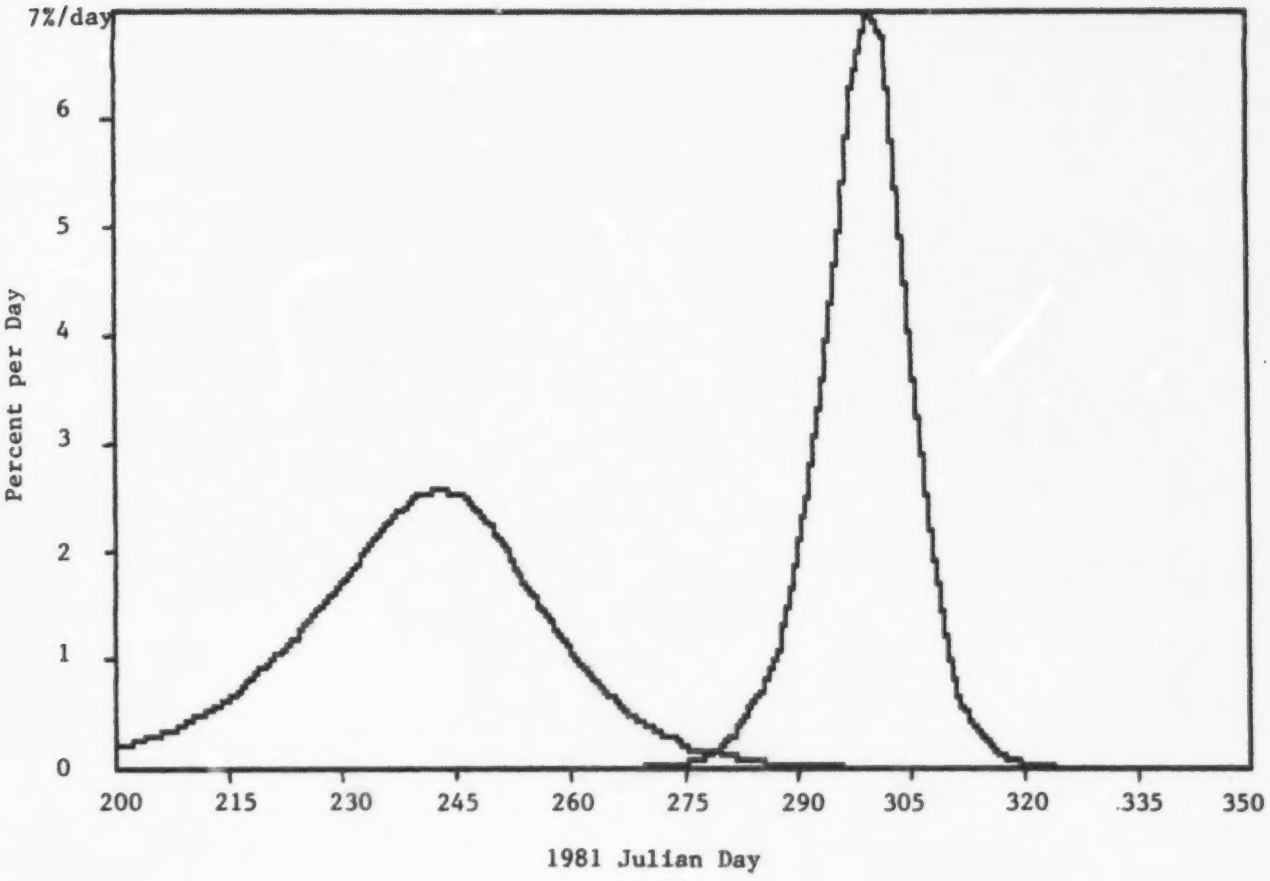

Fig. C1-81. Model reconstruction for 1981 adults with a 10-day pool time and parameters shown in Table 7. Daily run to the fishery and daily escapement are expressed as percentages of the total annual run arriving per day.

FIG. C2

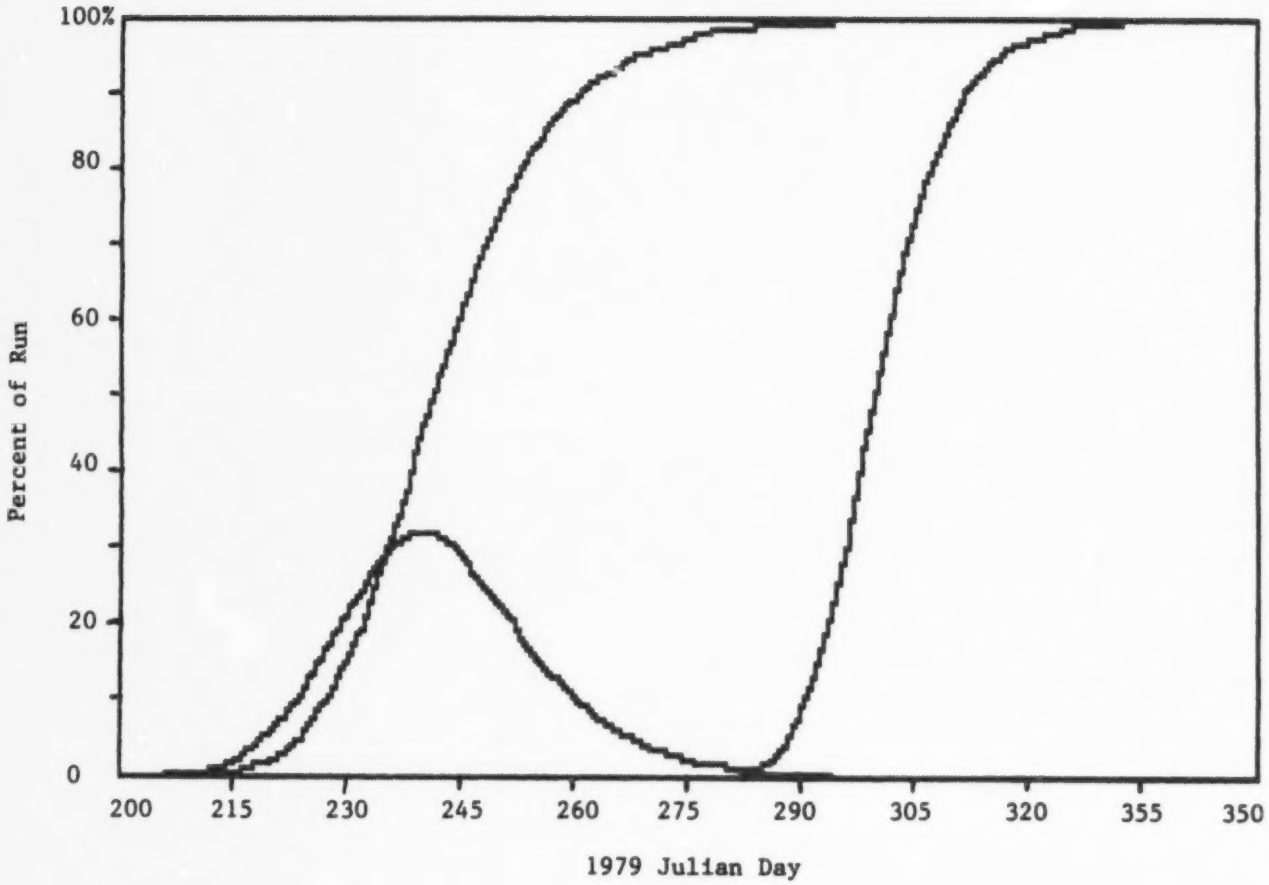

Fig. C2-79. Model reconstruction for 1979 adults with a 10-day pool time and parameters shown in Table 7. Cumulative fishery arrivals, pool size, and cumulative escapement are shown as percentages of the total annual run.

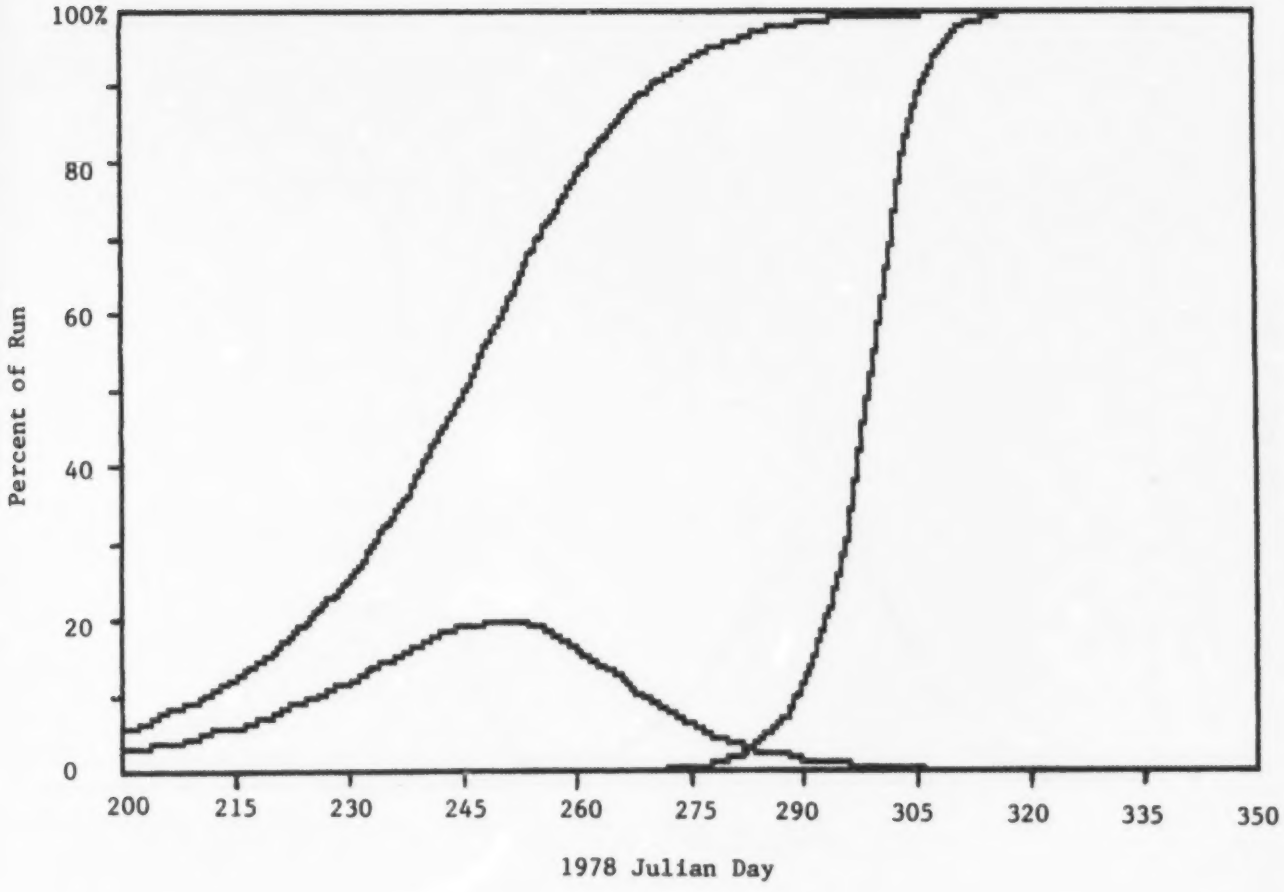

Fig. C2-78. Model reconstruction for 1978 adults with a 10-day pool time and parameters shown in Table 7. Cumulative fishery arrivals, pool size, and cumulative escapement are shown as percentages of the total annual run.

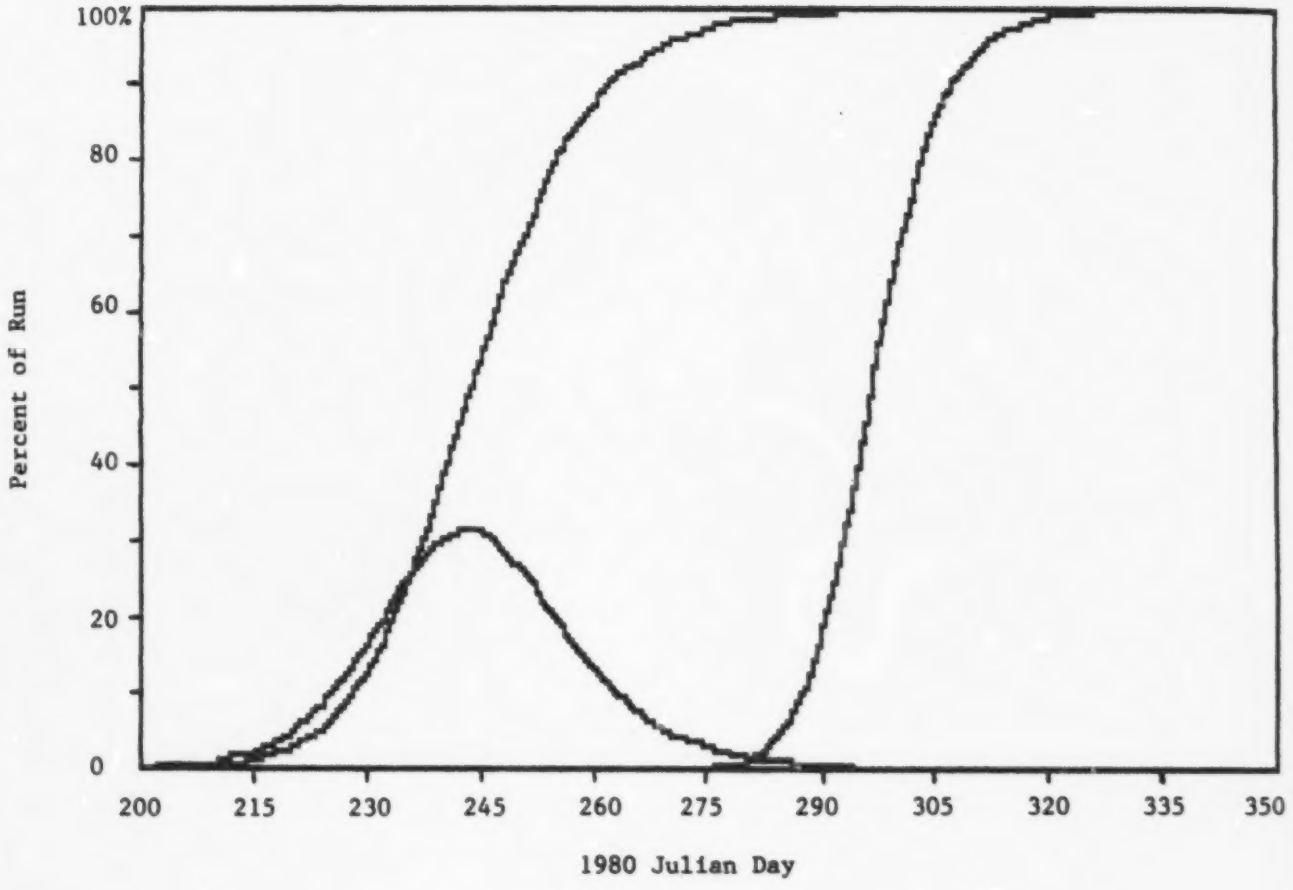

Fig. C2-80. Model reconstruction for 1980 adults with a 10-day pool time and parameters shown in Table 7. Cumulative fishery arrivals, pool size, and cumulative escapement are shown as percentages of the total annual run.

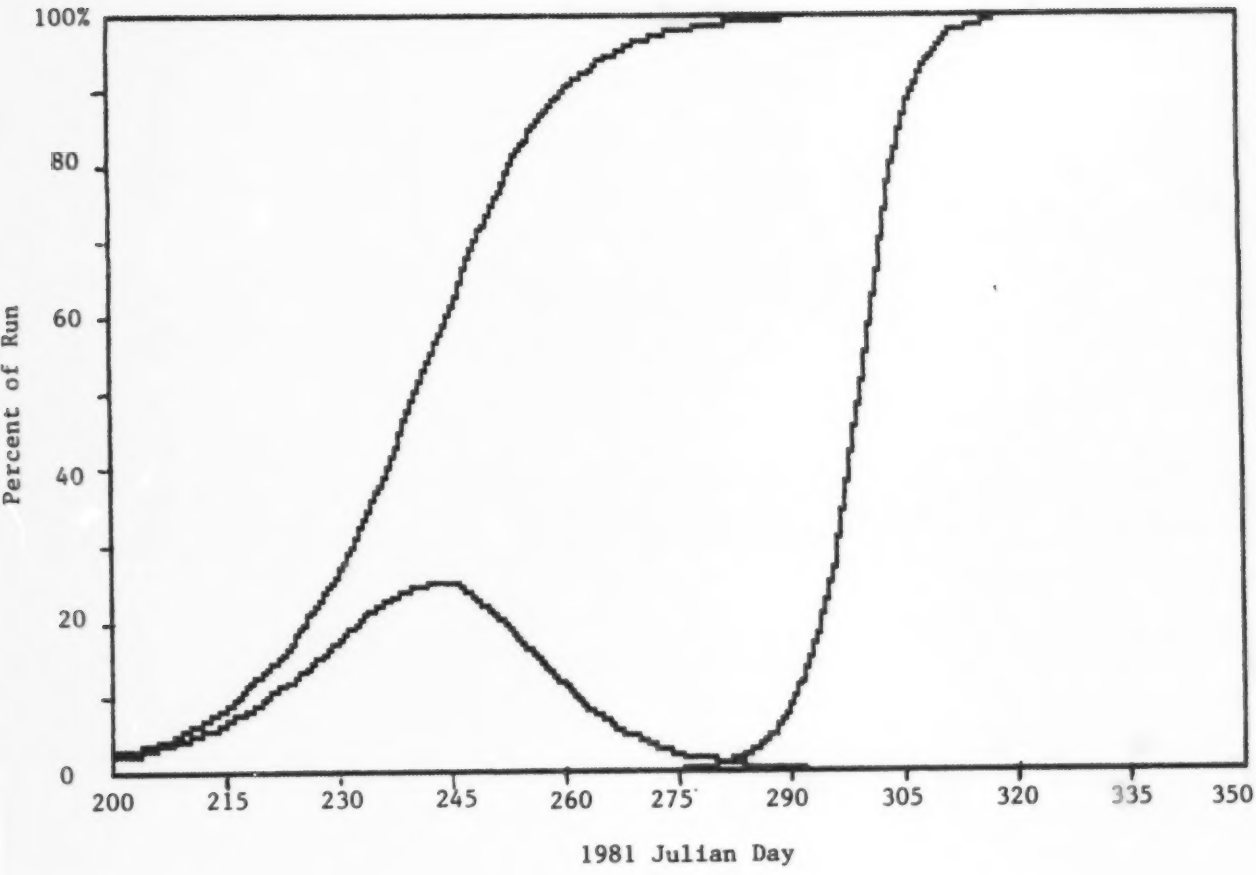

Fig. C2-81. Model reconstruction for 1981 adults with a 10-day pool time and parameters shown in Table 7. Cumulative fishery arrivals, pool size, and cumulative escapement are shown as percentages of the total annual run.